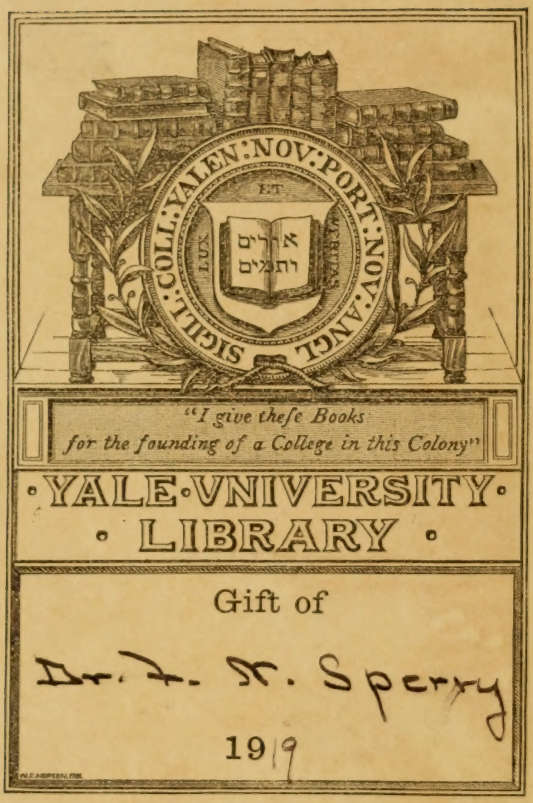

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THE SCIENCE AND ART

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MIDWIFERY

BY

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S.M.D.

TO

AUSTIN FLINT, M. D., LL. D.

IN MEMORY OF MANY YEARS OF FRIENDSHIP

THIS BOOK IS DEDICATED

BY THE AUTHOR

PREFACE TO THE FOURTH EDITION.

The third edition of this work, published in 1885, was intended to present to the reader a picture of the most advanced obstetrical teachings of that date. In the brief interval, however, that has elapsed since then the changes that have taken place in both the theory and practice of obstetrics have made it necessary for me to present to the profession what is essentially a new book. Thus many modifications in the theory have resulted from more careful observations in anatomy and pathology, and from fruitful physiological investigations. It has been my endeavor to interweave aseptic precautions with all branches of obstetric art without, however, insisting upon pedantic measures which experience has shown to be needless. But the noblest conquests of the past years have been the result of the employment of modern surgery for the relief or removal of a host of complications formerly regarded as beyond the pale of human help.

In making needed alterations I have not felt it obligatory when new discoveries have destroyed the value of former deductions to retain these in order to maintain a reputation for consistency.

I thank the medical press and the medical profession of this country and Great Britain for the flattering welcome they have hitherto extended to this treatise, and trust that in its new form it may command a like degree of favor.

For the preparation of the index special thanks are once more due to my friend Dr. W. H. Flint, whose painstaking accuracy will be evident to those who have occasion to consult these pages.

April 13, 1892.

CONTENTS.

PHYSIOLOGICAL ANATOMY.

CHAPTER I.

PAGE

FEMALE ORGANS OF GENERATION 1

The pudendum. — Labia majora. — Clitoris. — Labia minora.—Vestibule.—The bulbs of the vestibule.—Meatus urethræ.—Sebaceous glands.—Mucous glands.—Vaginal orifice.—Hymen.—Vagina.—Vessels of vagina.—Uterus.—Fallopian tubes.—Ovaries.—Vessels of uterus and its appendages.—Nerves of uterus.—Lymphatics.—Development of the female organs of generation.—Arrests of development.

PHYSIOLOGY OF THE OVUM.

CHAPTER II.

DEVELOPMENT OF THE OVUM 35

The Graafian follicles and the ovum.—Discharge of the ova from the ovary, and the formation of the corpus luteum.—The migration of the ovum.—Fecundation.—Changes taking place in the ovums subsequent to fecundation.—Nourishment of the embryo.—The allantois and chorion.—The deciduæ.—The placenta ; its development and structure.—Formation of the umbilical cord.—The amniotic fluid.

CHAPTER III.

DEVELOPMENT OF THE FŒTUS 62

Development of the fœtus in the successive months of pregnancy.—Fetal circulation.—Fœtus at term.—Fetal cranium.—Attitude, presentation and position of fœtus.

PHYSIOLOGY OF PREGNANCY.

CHAPTER IV.

CHANGES EFFECTED IN THE MATERNAL ORGANISM BY PREGNANCY . 77

Changes in the sexual apparatus and neighboring organs.—Changes in the uterus.—Explanation of apparent shortening of cervix.—Changes in the vagina, vulva, abdomen, navel, breasts, nipple.—Functional disturbances of bladder.—Constipation.—Œdema.—Changes effected in the entire organism.

CHAPTER V.

THE DIAGNOSIS OF PREGNANCY 91

Signs of pregnancy.—Suppression of menses.—Nausea.—Salivation.—Breasts.—Increase of abdomen.—Changes of the os and cervix.—Quickening.—Ballottement.—Fetal heart-beat.—Uterine bruit.—Funic souffle.—Interrogation of the patient.—Methods of physical examination.—Inspection of abdomen.—Palpation.—Auscultation.—The vaginal touch.—Distinction between first and subsequent pregnancies.—Diagnosis of death of fœtus.—Duration of pregnancy.—Prediction of day of confinement from date of last menstruation.—Date of quickening.—Size of uterus.

PREGNANCY.

CHAPTER VI.

PAGE

THE MANAGEMENT OF PREGNANCY 112

Hygiene of pregnancy.—The disorders of pregnancy.—The blood-changes of pregnancy.—Pernicious anæmia.—Hydræmic œdema.—Varicose veins.—Nausea and vomiting.—Heart-burn.—Insalivation.—Pruritus.—Faceache.—Cephalalgia.—Insomnia.

LABOR.

CHAPTER VII.

THE PHYSIOLOGY OF LABOR AND ITS CLINICAL PHENOMENA . . 123

Causes of labor.—Uterine contractions.—Action of labor-pains upon the uterine walls.—Contraction of ligaments.—Action of abdominal muscles.—Action of vagina.—The pain of labor.—General influence of labor-pains upon the organism.—Precursory symptoms of labor.—First, second, and third stages of labor.—Duration.—Action of the expellent forces.

CHAPTER VIII.

MECHANISM OF LABOR 140

Anatomical factors.—Anatomy of pelvis.—Sacrum.—Coccyx.—Ossa innominata—The ilia.—The pubes.—The ischia.—Articulations of the pelvis.—Sacro-iliac articulations.—Symphysis pubis.—The pelvic ligaments.—Obturator membrane.—Sacro-sciatic ligaments.—Inclination of the pelvis.—The pelvis as a whole.—The pelvic planes.—Plane of the brim.—Plane of the outlet.—Planes of the cavity.—Ischial planes.—Pelvic axis.—Differences between male and female pelvis.—Differences between the infantile and adult pelvis.—The soft parts of the pelvis.—The perineal floor.—The head of the fœtus at term.—Sutures and fontanelles.—The diameters of the fetal head.—The articulation of the head with the spinal column.

CHAPTER IX.

MECHANISM OF LABOR.—(*Continued.*) 168

Presentations: natural, unnatural, normal.—Vertex presentations: frequency, positions.—Manner in which head enters pelvis.—Positions, normal mechanism of labor.—Descent and flexion.—Rotation.—Extension.—External rotation.—Expulsion of the trunk.—Abnormal mechanism (vertex presentations).—Mechanism of occipito-posterior positions.—Configuration of the head in vertex presentations.—Molding.—Scalp-tumor.—Diagnosis of vertex presentations.

CHAPTER X.

MECHANISM OF LABOR.—(*Continued.*) 184

Face presentations.—Frequency.—Causes.—Mechanism.—Descent and extension.—Rotation.—Flexion.—External Rotation.—Abnormal mechanism.—Configuration of head.—Diagnosis.—Prognosis.—Treatment.—Brow presentations. — Breech presentations.—Causes. — Diagnosis.—Mechanism.—Irregular mechanism.—Configuration.—Prognosis.—Treatment.

CHAPTER XI.

CONDUCT OF NORMAL LABOR 205

Preliminary preparations.—Examination of the patient.—Management of the first stage.—Management of the second stage.—Preservation of the perinæum.—Delivery of the shoulders.—Tying the cord.—Third or placental stage.—Care of patient after delivery.—Treatment of perineal laeractions.—Anæsthetics in midwifery.

CHAPTER XII.

PAGE

MULTIFLE PREGNANCIES AND THEIR MANAGEMENT . . . 228

Frequency.—Origin.—Varieties.—Acardia.—Weight.—Unequal development. Superfetation.—Diagnosis. — Labor.—Presentations.—Simultaneous entrance of both children into the pelvis.—Locking.—Prognosis.—Conduct of labor.

THE PUERPERAL STATE.

CHAPTER XIII.

THE PHYSIOLOGY AND MANAGEMENT OF CHILDBED . . . 238

The puerperal state borders closely upon pathological conditions.—Post-partum chill.—Temperature.—The pulse.—General functions.—Retention of urine.—Loss of weight.—Involution.—Separation of the decidua.—Closure of the sinuses.—The cervix.—The vagina.—Position of uterus. After-pains.—The lochia.—The secretion of milk.—Anatomical considerations.—Milk-fever.—Composition of milk.—Diagnosis of the puerperal state.—The new-born infant.—Changes in circulation.—The navel. Tumor upon the presenting part.—Digestion.—Skin.—Icterus.—Loss of weight.—Management of puerperal state.—Sleep.—Passing urine.—Visits of physician.—Washing the vagina.—Diet.—Laxatives.—Nursing. —Duration of lying-in period.—Care of new-born infant.—Bath.—Cord. —Nursing.—Wet-nurses.—Artificial feeding.

THE PATHOLOGY OF PREGNANCY.

CHAPTER XIV.

ACCIDENTAL COMPLICATIONS.—ABNORMITIES OF THE UTERUS. . 260

Variola. — Rubeola. — Scarlatina. — Scarlatina puerperalis.—Cholera. — Typhus, typhoid, and relapsing fever.—Malarial fever.—Icterus.—Cardiac diseases.—Pneumonia.—Emphysema, chronic pleurisy, and empyema.—Phthisis.—Syphilis.—Chorea.—Surgical operations during pregnancy.—Double uterus.—Anteversion and anteflexion.—Retroversion.—Retroflexion.—Prolapse of uterus and vagina.—Hernias.

CHAPTER XV.

DISEASES OF THE DECIDUA.—DISEASES OF THE OVUM. . . 284

Endometritis decidua: 1. Chronica; 2. Tubersoa; 3. Catarrhalis.—Anomalies of the placenta.—Anomalies of form; of position; of development; of circulation.—Placentitis.—Degenerations.—Syphilis.—Anomalies of the amnion and of the amniotic fluid.—Hydramnion.—Deficiency of amniotic fluid.—Anomalies of the umbilical cord: torsion; knots; hernias; coiling of the cord; cysts; stenoses of vessels; marginal implantations. —Hydatidiform mole.

CHAPTER XVI.

THE PREMATURE EXPULSION OF THE OVUM 307

Causes of abortion.—Disposition to abortion.—Immediate causes.—Symptoms.—Moles.—Incomplete abortions.—Diagnosis.—Prognosis.—Treatment.—Prophylaxis.—Arrest of threatened abortion.—Treatment of inevitable abortion.—Treatment of neglected abortion.—Removal of fibrinous polypi.—Treatment of miscarriage.

CHAPTER XVII.

EXTRA-UTERINE PREGNANCY 327

Definition.—Tubal pregnancy.—Pregnancy in rudimentary cornu.—Interstitial pregnancy.—Tubo-abdominal and tubo-ovarian pregnancy.—Ovarian pregnancy.—Abdominal pregnancy.—Symptoms.—Termina-

PAGE

tions.—Diagnosis.—Treatment in cases of early gestation.—Cases of advanced gestation (fœtus living).—Cases of gestation prolonged after the death of the fœtus.

OBSTETRIC SURGERY.

CHAPTER XVIII.

THE INDUCTION OF PREMATURE LABOR 349

Induction of premature labor.—Indications.—Contracted pelvis.—Habitual death of fœtus.—Diseases which imperil the life of the mother.—Operation.—Catheterisatio uteri.—Intra-uterine injections.—Rupture of membranes.—Mechanical dilatation of cervix.—Vaginal douches.—Tampon.—Choice of methods.—Care of the child.—Artificial abortion.

CHAPTER XIX.

FORCEPS 361

History.—Varieties of forceps; short forceps; long forceps.—Action of forceps.—Indications.—Preparations.—Forceps at outlet.—Operation; introduction; locking; tractions; removal.—Forceps at brim; operation.—Axis-traction forceps.—Forceps in occipito-posterior positions; in face presentations.

CHAPTER XX.

EXTRACTION IN FOOT AND BREECH PRESENTATIONS . . . 382

Extraction in pelvic presentations.—Attitude of the physician.—Prognosis.—Position.—Extraction of trunk.—Extraction by the feet; by the breech.—Management of the cord.—Liberation of the arms.—Exceptional cases.—Extraction of the head.—Smellie's method.—Veit's method. Head at brim.—Prague method.—Forceps to the after-coming head.

CHAPTER XXI.

VERSION 400

Cephalic version.—External method.—Combined method.—Busch.—D'Outrepont.—Wright.—Hohl.—Braxton Hicks.—Podalic version.—Bipolar method.—Internal version.—Neglected version.—Use of the fillet.

CHAPTER XXII.

CRANIOTOMY AND EMBRYOTOMY 413

Craniotomy.—Indications.—Operation.—Perforators.—Method of perforating.—Extraction after perforation.—Forceps.—Cephalotribe.—Action of the cephalotribe.—Objections.—Application of the cephalotribe.—Cranioclast.—Crotchet and blunt hook.—Cephalotomy.—Embryotomy.—Exenteration.—Decapitation.

CHAPTER XXIII

CÆSAREAN SECTION.—OPERATIONS OF THOMAS AND PORRO . . 436

Cæsarean section.—History.—Indications.—Operation.—After-treatment.—Prognosis.—Operation of Porro.—Operation of Thomas.

THE PATHOLOGY OF LABOR.

CHAPTER XXIV.

ANOMALIES OF THE EXPELLENT FORCES 452

Precipitate labors.—Tardy labors.—Irregular pains in the first stage of labor.—Treatment of protracted first stage.—Irregular pains in the second stage.—Treatment of protracted second stage.—On the use of ergot in labor.—Irregular pains in the third stage; treatment.—Painful labors: from

PAGE

hysteria; from rheumatism; from intestinal irritation; from inflammatory changes.

CHAPTER XXV.

CONTRACTED PELVES 465

Varieties.—Frequency.—Diagnosis.—Pelvic measurements.—Forms of the contracted pelvis.—Justo-minor pelves.—Flattened non-rachitic pelves.—Rachitic flattened pelves.—Generally contracted, flattened pelves.—Irregular forms.—Pseudo-osteomalacia.—Scoliosis.—Kyphosis.—Influence of contracted pelves during pregnancy and labor.—Influence upon the uterus.—Influence upon the presentation.—Influence upon the pains.—Influence upon the first stage of labor.—Influence upon the mechanism of labor.—Effects of pressure upon the maternal tissues.—Influence upon the fetal head.—Effects of pressure upon the integuments; upon the cranium.—Prognosis.

CHAPTER XXVI.

TREATMENT OF CONTRACTED PELVES 493

Cases of extreme pelvic contraction, rendering delivery *per vias naturales* impossible.—Cases indicating craniotomy or premature labor.—Cases where extraction of a living child at term is possible.—Premature labor.—Version.—Forceps.—Expectant treatment.

CHAPTER XXVII.

RARE FORMS OF PELVIC DISTORTION 514

The Naegele oblique pelvis: morbid anatomy, etiology, diagnosis, mechanism of labor in, prognosis, treatment.—The kyphotic pelvis: morbid anatomy, etiology, diagnosis, prognosis.—Scolio-rachitic pelvis: anatomical characters.—Robert's pelvis: anatomy, etiology, diagnosis, prognosis.—Spondylolisthetic pelvis: anatomical characters, diagnosis, prognosis.—Funnel-shaped pelvis.—Osteomalacia.—Pelvis narrowed by exostoses.—Divided symphysis.

CHAPTER XXVIII.

ABNORMITIES OF THE SEXUAL ORGANS 535

Atresia of the genital canal.—Vulvar atresia.—Vaginal atresia.—Cystocele.—Rectocele.—Retention of urine.—Impacted calculi.—Vaginal hernias.—Cystic degeneration of the vaginal wall.—Vaginismus.—Echinococci.—Uterine atresia.—Conglutinatio orificii externi.—Cicatrical atresia.—Rigidity.—Thrombus of the cervix.—Symptoms of atresia.—Note on treatment.—Tumors.—Fibroids.—Cancer.—Ovarian tumors.

CHAPTER XXIX.

ABNORMITIES OF THE FŒTUS WHICH OFFER AN OBSTRUCTION TO DELIVERY 551

Premature ossification of the cranium.—Hydrocephalus.—Encephalocele.—Hydrothorax.—Ascites.—Other causes of abdominal distention.—Tumors of the trunk.—Monstrosities.—Double monsters.—Acardiaci.—Anencephalous monsters.—Abnormal positions.—Spontaneous version.—Spontaneous evolution.

CHAPTER XXX.

ECLAMPSIA 567

Definition.—Clinical history.—Prognosis, pathology, and etiology.—Treatment.

CHAPTER XXXI.

POST-PARTUM HÆMORRHAGE AND RETAINED PLACENTA . . 581

Normal agencies for checking haemorrhage.—Disturbances of contractility, of retractility, of thrombus formation.—Treatment.—Method of securing

PAGE

contraction and retraction.—Treatment of cerebral anæmia.—Retained placenta.

CHAPTER XXXII.

PLACENTA PRÆVIA.—ACCIDENTAL HÆMORRHAGE.—INVERSION OF THE UTERUS 594

Situation.—Varieties.—Frequency.—Causes of hæmorrhage.—Clinical features.—Prognosis.—Diagnosis.—Treatment.—Accidental hæmorrhage.—Inversion of the uterus.

CHAPTER XXXIII.

RUPTURES OF THE GENITAL CANAL 610

Rupture of the uterus.—Etiology.—Pathological anatomy.—Symptoms and diagnosis.—Treatment.—Prophylaxis.—Treatment after rupture.—Rupture limited to the peritoneal covering of the uterus.—Perforation from pressure.—Lacerations of the vaginal portion.—Laceration of the vagina.—Laceration of the vulva.—Thrombus of the vulva and vagina.—Rupture of the pelvic articulations.

CHAPTER XXXIV

PROLAPSE OF THE FUNIS, ETC. 629

Prolapsed funis.—Asphyxia neonatorum.—Collapse and sudden death during labor and childbed from thrombosis, from embolism, and from entrance of air into the circulation.—On the extraction of the child in case of death of the mother in pregnancy or labor.—Tympanites uteri.

DISEASES OF CHILDBED.

CHAPTER XXXV.

PUERPERAL FEVER 653

Definition.—Frequency.—Morbid anatomy.—Endometritis and endocolpitis.—Metritis and parametritis.—Pelvic and diffused peritonitis.—Phlebitis and phlebothrombosis.—Septicæmia.—Earlier views concerning the nature of puerperal fever.—The nature of puerperal fever as regarded from the standpoint of modern investigation.—General symptoms.—The symptoms of endometritis and endocolpitis; of parametritis and perimetritis; of general peritonitis; of septicæmia lymphatica; of septicæmia venosa; of pure septicæmia.

CHAPTER XXXVI.

PUERPERAL FEVER.—(*Continued.*) 681

Causes.—The atmosphere.—Inoculation.—Season of the year.—Social state.—Relations to zymotic diseases.—The prevention of puerperal fever.—Treatment.—Vaginal and uterine injections.—Iodoform bacilli; opium; leeches; stupes; laxatives; quinine; salicylate of sodium; Warburg's tincture; veratrum viride; digitalis; antipyrine; alcohol; cold.—Treatment of peritoneal effusions and inflammatory exudations.

CHAPTER XXXVII.

PUERPERAL INSANITY.—PHLEGMASIA ALBA DOLENS.—DISEASES OF THE BREASTS 701

The insanity of pregnancy, of childbed, of lactation.—Phlegmasia alba dolens.—Defective milk secretion.—Galactorrhœa.—Sore nipples.—Subcutaneous inflammation of the breast.—Submammary abscess.—Parenchymatous mastitis.—Galactocele.—Prophylaxis of ophthalmia neonatorum.

LIST OF ILLUSTRATIONS.

FIGURE		PAGE
1.	The external parts of generation (in the virgin). (Sappey.)	2
2.	Lateral view of the erectile structures of the external organs of the female (from Kobelt), two thirds	3
3.	Front view of the erectile structures of the external organs of the female (Kobelt.)	4
4.	Vulva of a woman who has borne children. (Sappey.)	6
5.	Section through the female pelvis. (Kohlrausch, modified by Spiegelberg.)	8
6.	Complete genital organs of the female. (Beigel.)	11
7.	Virgin uterus. (Sappey.)	12
8.	Multiparous uterus. (Sappey.)	13
9.	Virgin uterus opened posteriorly. (Bandl.)	14
10.	Uterus of a woman who has borne children. (Bandl.)	15
11.	Section through the mucous membrane of a normal virgin uterus, magnified about forty diameters. (Kundrat and Engelmann.)	17
12.	Section through uterus, showing cavity. (Weber.)	18
13.	Posterior lateral view of the uterus, with portion of lig. latum, oviduct, and ovary. (Henle.)	20
14.	Section through Fallopian tube. (Richard.)	20
15.	Section through ampulla (thirty diameters). (Luschka.)	21
16.	Longitudinal section of ovary from a person aged eighteen (eight diameters). (Henle.)	22
17.	Arterial vessels in a uterus ten days after delivery. (Luschka.)	24
18.	Uterine and utero-ovarian veins (plexus pampiniformis). (Sappey.)	25
19.	Nerves of the uterus. (Frankenhaeuser.)	28
20.	Rudimentary sexual organs. (Luschka.)	29
21.	Uterus and its appendages in the fœtus at the end of the fourth month (natural size). (Courty.)	29
22.	Uterus unicornis from a young child, posterior aspect. (Pole.)	30
23.	Double uterus and vagina from a girl aged nineteen. (Eisenmann.)	31
24.	Uterus bicornis, double cavity and double vagina, from a girl seventeen years of age. (Schroeder.)	32
25.	Uterus cordiformis, double natural size. (Kussmaul.)	32
26.	Uterus septus bilocularis. (Cruveilhier.)	33
27.	Uterus semi-partitus. (Gravel.)	34
28.	Section of Wolffian body, with rudimentary ovary (embryo of chick, fourth day of incubation). (Waldeyer.)	35
29.	Section through portion of the ovary of mammal. (Wiedersheim.)	36
30.	Sagittal section of the ovary of an adult bitch (after Waldeyer).	37
31.	Spermatozoa from the human subject (magnified eight hundred diameters). (Luschka.)	43

FIGURE PAGE

32. Ovum of the nephelis vulgaris, showing retraction of vitellus and the penetration of the spermatozoa through the vitelline membrane (magnified three hundred diameters). (Robin.) 44
33. Fertilization of ovum of a mollusk (Elysia viridis). 45
34. Formation of the blastodermic vesicle. (Van Beneden.) 46
35. Diagrammatic section (Haddon) of mammalian blastoderm. . . . 47
36. Surface view of area pellucida of hen's egg, after eighteen hours of incubation. (Balfour.) 47
37. Dorsal view of embryonic area of blastoderm of chick. 48
38. Transverse section through the embryo of the chick, a few hours after the commencement of incubation. 48
39. Diagram representing transverse section through the embryo of a chick, at the end of the first day of incubation. 48
40. Transverse section through the embryo of a chick, on the second day of incubation (magnified one hundred diameters). 49
41. Section through the ovum of chick, after the development of umbilical vesicle 49
42. Diagram showing early stage in development of amnion. 51
43. Diagram showing completion of the amnion and formation of the chorion . 51
44. Human embryo at the third week, showing villi covering the entire chorion. (Haeckel.) 52
45. Diagram showing the exochorion; endochorion; umbilical vesicle; amnion and pedicle of allantois 52
46. Diagram showing the formation of the decidua, first stage 53
47. Diagram showing the formation of the decidua completed 54
48. Diagram showing the branching of the villi and the connection of the larger trunks with the placenta 56
49. Diagram of uterus and placenta in the fifth month 58
50. Diagram of the umbilical arteries and vein. (Tarnier and Chantreuil.) . 60
51. Human germs or embryos from the second to the fifteenth week (natural size). (Principally after Ecker.) 63
52. Diagram of the fetal circulation. (Flint.) 67
53. Fetal skull, seen from the side. (J. Veit.) 71
54. Fetal skull, seen from above. (J. Veit.) 71
55. Attitude of fœtus *in utero*. (Tarnier and Chantreuil.) 73
56. Lower segment of uterus, sixth month of pregnancy. (Hofmeier.) . . 79
57. Diagram showing apparent shortening of cervical canal 83
58. Uterus from a multipara who died in the last month of pregnancy, showing cervix of normal length, with membranes adherent to the os internum. (Bellevue Hospital.) 86
59. Diagram for computing pregnancy. (Schultze.) 109
60. Schultze diagram 110
61. Diagram showing the mucous membrane of the uterus. 125
62. Diagram showing shape of uterus during a pain. (Lahs.) 128
63. Diagram showing elevation of fundus during a pain. (Lahs.) . . . 128
64. Diagram showing the changes in the thickness of the uterine walls during labor. (Lahs.) 129
65. Section through a frozen corpse. Stage of expulsion. (Braune.) . . 132
66. The uterus and parturient canal. Fœtus removed. (Braune.) . . . 133
67. Longitudinal section through walls of uterus in eighth month of pregnancy. (Bandl.) 137
68. Sacrum and coccyx (anterior surface.) 141

FIGURE PAGE
69. Section of sacrum and coccyx 142
70. Os innominatum, before consolidation 143
71. Outer surface of os innominatum 143
72. Inner surface of os innominatum 144
73. Section through the left sacro-iliac articulation (natural size). (Luschka.) 145
74. Section of symphysis. (Luschka.) 146
75. Front view of pelvis, with ligaments. (Quain.) 146
76. Transverse section through pelvis, to show the sacro-sciatic ligaments. (Tarnier and Chantreuil.) 147
77. Section showing the inclination of the pelvis according to Naegele. (Tarnier and Chantreuil.) 148
78. Diagram showing oscillatory movements of sacrum. (Duncan.) . . 149
79. Anterior half of the pelvis 149
80. Posterior half of the pelvis 150
81. Diameters of the brim 151
82. Diameters of the outlet 151
83. Section showing the inclination of the pelvis according to Naegele. (Tarnier and Chantreuil.) 152
84. Axis represented upon a vertical section through a plaster cast of the pelvic cavity. (Hodge.) 153
85. Vertical section of a female infantile pelvis. (Fehling.) 154
86, 87. Diagrammatic representations of sections through the infantile and adult pelves. (Schroeder.) 155
88. Pelvis covered with the soft parts, with removal of bladder, uterus, and rectum. 157
89. Section of pelvis, showing the pyriform muscles. (Tarnier and Chantreuil.) 158
90. Section of pelvis, showing the internal obturator muscle. (Tarnier and Chantreuil.) 159
91. The levator-ani muscle, as seen from above. (Dickinson.) 160
92. The levator, seen from the side, when the ischium is removed. (Redrawn from Luschka by Dickinson.) 161
93. Antero-posterior section of the perineal floor. (Tarnier and Chantreuil.) 162
94. Muscles of the perinæum. (Henle.) 163
95. The parturient canal. (Hodge.) 164
96. Lateral view of fetal skull. (Hodge.) 165
97. Fetal head, as seen from above. (Hodge.) 165
98. Antero-posterior and vertical diameters of the fetal head. (Tarnier and Chantreuil.) 167
99. Vertex presentation; child surrounded by amniotic fluid. (Pinard.) . 172
100. Figure illustrating the mechanism of labor in occipito-anterior deliveries. (After Schultze.) 174
101. Attitude of fœtus. (Tarnier and Chantreuil.) 176
102. Figure illustrating the mechanism of labor in occipito-posterior positions. (After Schultze.) 179
103. Outlines showing difference between head of child at birth and four days subsequent to delivery. (Budin.) 180
104. Figure showing shape of head in occipito-posterior deliveries. (Tarnier and Chantreuil.) 181
105. Method of performing external palpation. (Pinard.) 182
106. Attitude of head in face presentations. (Ribémont.) 186
107. Engagement of the head in face presentations. (Tarnier and Chantreuil.) 187

FIGURE PAGE
108. Mechanism of face presentations. (Schultze.) 188
109. Face presentation, chin to the rear. (Hodge.) 189
110. Outline of head born with face presenting 190
111. Same head five days later. (Budin.) 190
112-114. Diagrams showing Schatz's method of converting face presentations into vertex presentations 192
115. Outline of head after delivery, the brow presenting. (Budin.) . . . 194
116. Brow presentation, subsequently converted into that of the face. (Maternity Hospital.) 195
117. Presentation of the breech. Left dorso-anterior position. (Pinard.) . 198
118. Showing lateral inflexion of the trunk during delivery of the breech. . 200
119. Exit of head in breech presentations. Face covered by perinæum. (Farabœuf and Varnier.) 201
120. Exit of head in breech presentations 202
121. Showing shape of head in breech presentations. (Budin.) 203
122. Expression of the placenta. (Credé.) 220
123. Descent of the placenta according to Schultze 222
124. Showing normal descent of placenta. (Duncan.) 223
125. Twin placenta, showing arterial anastomosis 229
126. Author's case of acardia 230
127. Twin pregnancy, both heads presenting. (Tarnier and Chantreuil.) . 233
128. Twin pregnancy, head and breech presenting. (Tarnier and Chantreuil.) 235
129. Mammary gland. (Liegeois.) 246
130. Section through acinus from breast of a nursing woman. (Billroth.) . 248
131. Torsion of the cord. (Schauta.) 294
132. Knot of umbilical cord. (Leyman.) 295
133. Insertio velamentosa. (Lobstein.) 297
134. Specimen from hydatidiform mole, in the Wood Museum 299
135. Ovum, with imperfectly developed decidua; outer surface of vera. (Duncan.) 309
136. Uterus with basis of a fibrinous polypus, after an abortion. (Fränkel.) 314
137. Intraperitoneal rupture of tube 329
138. Rupture of tube between the folds of the broad ligament 330
139. Pregnancy in rudimentary cornu. (Küssmaul, observed by Heyfelder.) 332
140. Interstitial pregnancy. (Hennig.) 333
141. Bifurcation of tubal canal. (Hennig.) 334
142. Credé's apparatus for the maintenance of the body-heat of premature and feeble infants 357
143. Section of hospital incubator. (Tarnier.) 358
144. Forceps of Chamberlen. 362
145. Forceps of Smellie. 362
146. Levret's forceps 363
147. Naegele's forceps 364
148. Simpson's forceps 365
149. Hodge's forceps 365
150. Introduction of blades 370
151. Blades of the Tarnier forceps adjusted to the sides of the head at outlet. (Farabœuf and Varnier.) 371
152. Method of making tractions 373
153. Position of operator when head is on perinæum 374
154. Forceps applied to head at brim 375
155. Taylor's narrow-bladed forceps 376

FIGURE PAGE
156. Author's modification of Tarnier's forceps 378
157. Occipito-posterior position. Traction in a downward direction, to secure the descent of the head beneath the pubic arch. (Farabœuf and Varnier.) 380
158. Occipito-posterior position. Elevation of handle of forceps, to aid the rotation of the occiput over the perinæum. (Farabœuf and Varnier.) . 380
159. Taylor's method in mento-posterior positions of the face 382
160. Method of seizing the breech 385
161. Method of seizing both extremities 387
162. Tarnier forceps applied to the thighs. (Ollivier.) 389
163. The fillet, in dorso-anterior position. (Ollivier.) 390
164. The fillet in dorso-posterior position. (Ollivier.) 391
165. Porte-fillet. (Ollivier.) 393
166. Combined traction upon mouth and shoulders. (Farabœuf and Varnier.) 397
167. The method of extraction by the Prague method 398
168. The Prague method of extracting the head 399
169. Chin arrested at symphysis. (Chailly-Honoré.) 400
170. D'Outrepont's method, modified by Scanzoni 402
171. Version in head presentations. (Chailly-Honoré.) 406
172. Version in dorso-anterior position, first stage. (Farabœuf and Varnier.) 408
173. Version in dorso-anterior position, second stage. (Farabœuf and Varnier.) 409
174. Version in dorso-posterior position. (Farabœuf and Varnier.) . . . 410
175. Method of seizing the foot, in breech cases. (Farabœuf and Varnier.) . 411
176. Braun's repositor 412
177. Catheter used as a repositor 412
178. Scissors of Smellie 415
179. Simpson's perforator 415
180. Blot's perforator 415
181. Hodge's craniotomy scissors 415
182. Thomas's perforator 416
183. Simpson's basylist 416
184. Trephine perforator 416
185. Operation for perforating the child's head 417
186. Cephalotribe of Blot 421
187. Cephalotribe of Scanzoni 421
188. The author's cephalotribe 422
189. Simpson's cranioclast 426
190. Braun's cranioclast 427
191. Head of child after delivery with the cranioclast. (Simpson.) . . . 427
192. Meigs's craniotomy forceps (modified by Professor I. E. Taylor.) . . 429
193. Crotchet 429
194. Dr. Taylor's right-angled blunt hook 430
195. Segment removed by the Tarnier forceps-saw. (P. Thomas.) . . . 431
196. Braun's decapitating hook 432
197. Braun's method of decapitation 433
198. Embryotome of P. Thomas 434
199. Embryotome adjusted around the neck of the child 435
200. Baudelocque's pelvimeter 467
201. Schultze's pelvimeter 468
202. Normal inclination of the symphysis pubis. (Spiegelberg.) . . . 470
203. Diminution of angle between symphysis and pelvic brim 470

FIGURE PAGE
204. Increase of angle between symphysis and pelvic brim. 470
205. Specimens from the Wood Museum (Bellevue Hospital). No. 1, Normal pelvis. No. 2. Justo-minor pelvis 473
206. Flattened rachitic pelvis. (Wood's Museum.) 475
207. Small symmetrical rachitic pelvis. (Wood's Museum.) 478
208. Pseudo-osteomalacia. (Naegele.) 478
209. Scoliosis. (Litzmann.) 479
210. Pressure-mark upon skull. (Dohrn.) 490
211. Base of skull 504
212. Method of applying suprapubic pressure. (Mundé.) 505
213. Naegele oblique pelvis. (From specimen in the Wood Museum.) . . 515
214. Specimen of kyphotic pelvis. (Litzmann.) 519
215. Specimen of scolio-rachitic pelvis. (Litzmann.) 522
216. Robert's pelvis. (Lambl.) 523
217. Spondylolisthetic pelvis. (Kilian.) 525
218. Osteomalacia. (Specimen from Wood's Museum.) 530
219. Osseous tumors filling pelvic cavity. (Naegele.) 533
220. Author's case of acardia 558
221. Neglected shoulder presentation. (Chiara.) 565
222. Birth with doubled body. (Kleinwächter.) 566
223. Diagram showing a relaxed and a contracted uterus 583
224. Bimanual compression of uterus. (Breisky.) 586
225. Diagram showing unavoidable placental separation as a consequence of cervical dilatation 597
226. Inversion of uterus 608
227. First stage of replacement 609
227a. Second stage of replacement 609
228. Diagram showing dangerous thinning of lower segment, owing to the non-descent of the head in contracted pelvis. (Bandl.) 611
229. Case of ruptured uterus. 613
230. Retraction in a case of shoulder presentation. (Bandl.) 617
231. Robertson's repositor 634
232. Specimens of micrococci 665

PLATE FACING PAGE
I. Section through pelvic organs of multipara, *ad naturam*. (Freund.) . 8
II. Fig. 1. Deutoplasm-forming ovum from a Graafian follicle of a woman twenty-seven years old.
Fig. 2. Fresh ovum from Graafian follicle of a woman thirty years old. } (Nagel.) . 38
III. Fig. 1. Human embryo at the ninth week
Fig. 2. Human embryo at the twelfth week } (Erdl.) 52
IV. Microscopic sections in puerperal endometritis. (Bumm.) 667

THE

SCIENCE AND ART OF MIDWIFERY.

PHYSIOLOGICAL ANATOMY.

CHAPTER I.

FEMALE ORGANS OF GENERATION.

The pudendum.—Labia majora.—Clitoris.—Labia minora.—Vestibule.—The bulbs of the vestibule.—Meatus urethræ.—Sebaceous glands.—Mucous glands.—Vaginal orifice.—Hymen.—Vagina.—Vessels of vagina.—Uterus.—Fallopian tubes.—Ovaries.—Vessels of uterus and its appendages.—Nerves of uterus.—Lymphatics.—Development of the female organs of generation.—Arrests of development.

The female organs of generation may be properly divided as follows: 1. The external parts, or pudendum, and the vagina. 2. The uterus, Fallopian tubes, and ovaries.

The external parts and vagina are chiefly concerned in the act of copulation. As they likewise constitute the channel through which the child passes during parturition, a knowledge of their anatomical structure becomes of importance to those who would practice the obstetric branch of medicine.

The internal organs, i. e., the uterus, Fallopian tubes, and ovaries, assume obstetrical importance in connection with the parts they play in gestation. Thus, the ovary furnishes the germ from which the new being is developed. The Fallopian tube receives the germ, and conveys it to the uterus. In the uterus, the fecundated germ obtains the nutritive materials necessary for its subsequent growth and development.

I. The External Parts of Generation and Vagina.

The Pudendum.—The pudendum comprises all those parts which are perceptible externally. It includes the mons Veneris, the labia, the clitoris, the nymphæ, and the hymen. It is situated at the lower

opening of the pelvis, and has a wedge-shape, whence the term *cunnus*, i. e., *cuneus*. Its base is formed by the *mons Veneris*, a fatty cushion, abundantly supplied with hair, which covers the symphysis pubis. As it follows the curvature of the lower portion of the trunk, in extreme inclination of the pelvis it is sometimes directed so far backward as to render difficult the introduction of the speculum and the accomplishment of the sexual act. It is divided in the median line by the *rima pudendi*, which extends from the mons Veneris to the perinæum. Upon each side of the rima there are two longitudinal, slightly curved, and rounded folds of integument, which rest upon cushions of adipose areolar tissue. These folds constitute the so-called *labia majora*, which, like the mons Veneris, are covered, though to a less extent, with hair. In healthy young women they are firm and full, while in deteriorated constitutions, and in advanced life, they become wrinkled and pendulous, from diminution of the adipose tissue.

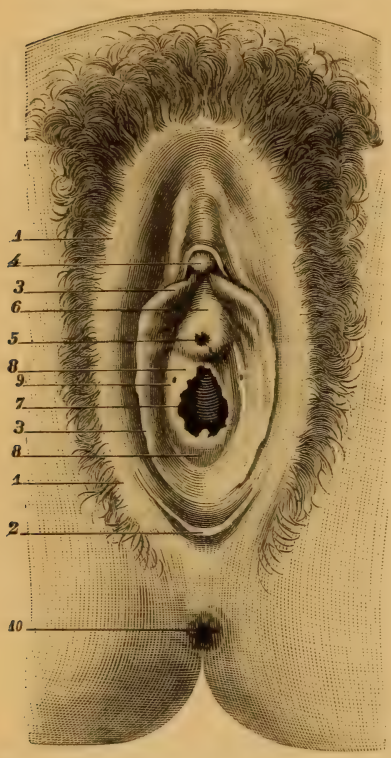


FIG. 1.—The external parts of generation (in the virgin). 1, labium majus; 2, fourchette; 3, the nympha; 4, glans clitoridis; 5, meatus urethræ; 6, vestibule; 7, orifice of vagina; 8, hymen; 9, orifice of the glands of Duverney; 10, anal orifice. (Sappey.)

The labia majora act as a sort of valve, which closes the orifice of the vagina, whence the term vulva—i. e., valva, the folding-door of the ancients. When the labia are full and well rounded, they are approximated closely together, and form the *vulva connivens*. With the loss of adipose tissue, a gaping of the flaccid labia ensues, and forms the *vulva hians*.

The labia offer an external and internal surface. The outer surface presents the usual characteristics of tegumentary tissue, and is abundantly supplied with large sebaceous glands. The inner surface is in all respects like a mucous membrane, except that it possesses sebaceous glands in place of mucous follicles. The subcutaneous tissue is composed of connective tissue, rich in elastic elements, and containing fatty lobules continuous with the underlying adipose structure. It furnishes support to an abundant venous plexus, to which the turgescence of the labia *in pruritu*, and under sexual excitement, is

mainly due. The existence of contractile elements has never been demonstrated.

The two extremities of the vulva have been designated, respectively, the *anterior* and *posterior commissures of the labia;* but these terms, so far as they convey the idea of connecting bands between the labia, are incorrect, for Luschka* has shown that the labia are directly continuous with the mons Veneris in front and the perinæum behind.

FIG. 2.—Lateral view of the erectile structures of the external organs of the female (from Kobelt), two thirds. The blood-vessels have been injected, and the skin and mucous membrane have been removed. *a*, bulbus vestibuli; *c*, plexus of veins, named the pars intermedia; *e*, glans clitoridis; *f*, corpus clitoridis; *k*, dorsal vein; *l*, right crus clitoridis; *m*, vestibulum; *n*, right gland of Bartholin or Duverney.

The *clitoris* is a small, elongated body, situated beneath the so-called anterior commissure. It resembles the penis in form and structure, but differs in possessing neither corpus spongiosum nor urethra. The clitoris is divided into the crura, the corpus, and the glans. The *crura* are long, spindle-shaped processes, attached to the borders of the ascending rami of the ischia and the descending rami of the pubis. The *corpus* is formed by the junction of the crura in the median line, just beneath the pubic arch. Even in a state of extreme erection, it does not normally exceed an inch in length. The *glans* is the rounded, imperforate extremity. During erection it attains the dimensions of a small pea. The cuticular covering of the glans is of a pale-red color, and is covered with papillæ, part of which contain vessels, and part, nerve-endings similar to those found in the nipple, and termed by Krause "terminal bulbs" (*End-Kolben*). The nerves of the clitoris are more fully developed than the corresponding nerves in the penis. The clitoris is regarded as the seat of the voluptuous sensations experienced by the female during copulation.

The *labia minora* are two narrow, reddish, moist folds of mucous membrane, situated between the labia majora, with which they are continuous by their outer surface. The inner surface is continuous with the mucous membrane of the vestibulum. They are, sometimes, termed likewise the *nymphæ*. *Nymphæ vocantur vel quod sint castitatis præsides, vel quod sponsum primo intermittant, vel quod aquis prosilientibus præsint* (Plazzonus),† or, as Sir Charles Bell words it

* LUSCHKA, Die Anatomie des menschlichen Beckens, p. 407.

† *Ibid.*, Tübingen, 1864, p. 403.

in his Anatomy, "The most modest of the uses ascribed to them is that of directing the stream of urine." When the rima pudendi is narrow, as in virgins, the labia minora are concealed and protected by the labia majora. In the vulva hians, the labia minora acquire, from exposure to the atmosphere, a dirty-bluish color, and take on the properties of the cutis. In Hottentot and Bushman women, they sometimes reach the length of eight inches, and constitute the so-called "Hottentot apron."

Each labium minus splits anteriorly into two folds, of which the outer joins the corresponding one of the opposite side to form a cover for the clitoris, the *præputium clitoridis*. The lower folds converge to meet beneath the lower border of the glans clitoridis, and form the *frenulum* of the clitoris. This attachment serves to bring the clitoris forward into contact with the penis, as the labia minora are pressed inward during copulation.

The labia minora meet posteriorly, in most instances, and form a thin circular band, the *frenulum vulvæ* or *fourchette*. The fourchette has usually been regarded as the posterior commissure of the labia majora; but this view Luschka has shown to be incorrect.*

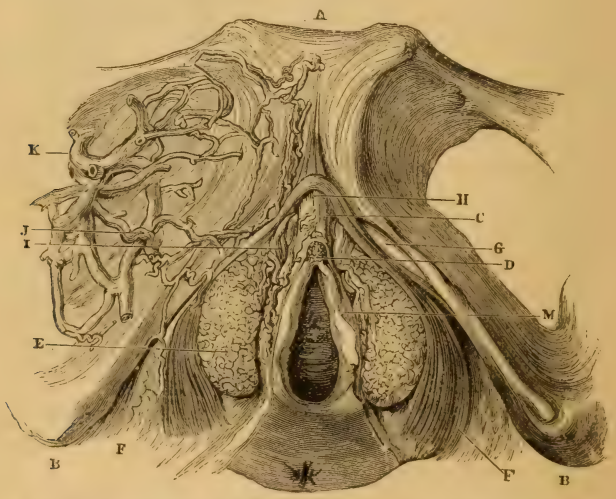


FIG. 3.—Front view of the erectile structures of the external organs of the female (Kobelt). A, pubis; B, B, ischium; C, clitoris; D, gland of the clitoris; E, bulb; F, constrictor muscle of the vulva; G, left pillar of the clitoris; H, dorsal vein of the clitoris; I, intermediary plexus; J, vein of communication with the obturator vein; K, obturator vein; M, labia minora.

The *vestibulum* is the angular space bounded by the labia minora and the vaginal orifice.

The *bulbi vestibuli vaginæ*, the bulbs of the vaginal vestibule, are two curved, leech-shaped masses of reticulated veins, situated between

* LUSCHKA, Die Anatomie des menschlichen Beckens, Tübingen, 1864, p. 404.

the vestibulum and pubic arch of each side. Kobelt has shown that they correspond to the two separated halves of the male bulbus urethræ. They are composed of erectile tissue, and measure, when distended with blood, a little over an inch in length. As the head of the child passes through the vulva during parturition, these bodies are pressed forward to prevent their being compressed between the head and the pubic arch. Still, rupture does sometimes occur, and then the hæmorrhage leads to the formation of thrombus of the labia majora. The upper ends of the vaginal bulbs are rather pointed, and communicate, by means of a small plexus, the *pars intermedia* of Kobelt, with the vessels of the glans clitoridis. Through this connection the blood is pressed, during venereal excitement, by the reflex contractions of the musculus constrictor cunni, from the turgid bulbs into the glans of the clitoris.

The *meatus urethræ* is situated in the median line, at the lower portion of the vestibular space, about three quarters of an inch from the glans of the clitoris. It is surrounded by a ring of muscular fibers, which keep it closed under ordinary circumstances. These fibers cause a puckering of the mucous membrane, which is easily recognized by the experienced finger, and serves as a guide for the introduction of the catheter.

Sebaceous glands are found in great abundance in the tissues of the nymphæ, where they furnish a fatty, yellowish-white material, possessing a peculiar odor. This material, when accumulated beneath the prepuce of the clitoris, constitutes the *smegma præputii*, so common in women who neglect the niceties of the toilet.

The *mucous glands* of the vulva are divided into the glandulæ vestibulares majores and the glandulæ vestibulares minores.

The *glandulæ vestibulares minores* are from five to seven in number, and are irregularly distributed in the neighborhood of the meatus urethræ. They are of the compound racemose variety, of about the size of poppy-seed, and possess short, wide ducts with large orifices. Tyler Smith says that one of these lacunæ may be enlarged sufficiently to admit a small-sized catheter, leading the operator to suppose that he has reached the bladder, while the instrument is really in a *cul-de-sac*.*

Professor Skene,† of Brooklyn, has drawn attention to the existence of two glandular structures, from three eighths to three quarters of an inch in length, situated in the muscular walls of the urethra. The orifices of these glands are found about an eighth of an inch above (within) the outer border of the meatus. The correctness of this observation I have had frequent opportunity to verify.

* W. Tyler Smith, Manual of Obstetrics, p. 22.

† Skene, The Anatomy and Physiology of Two Important Glands of the Female Urethra, American Journal of Obstetrics, April, 1880, p. 265.

The *glandulæ vestibulares majores* were first discovered in the human subject by Bartholin, and bear sometimes his name and sometimes that of Duverney. They are two in number, of the size of a pea, and of a reddish-yellow color. They are situated behind the posterior extremities of the bulbi vestibuli, which, however, they partially overlap. They are of the compound racemose variety, and their acini open into a duct a little over a half-inch in length, wide at its beginning, but which narrows toward its orifice. The duct takes an oblique course along the inner side of the vaginal bulbs, and terminates in front of the hymen, at the angle which the hymen or its remains (the carunculæ myrtiformes) makes with the walls of the vestibule. The glands of Bartholin secrete a yellowish, adhesive fluid, which is poured out freely during coitus, and preparatory to the passage of the child at the time of labor. This secretion, by rendering the parts moist and slippery, serves to protect the mucous surfaces from mechanical injury. An abundant secretion may likewise be caused by erotic dreams, or, in fact, by any form of sexual excitement. They are more developed in young persons than in those of middle life, and in old age they seem in some cases to disappear altogether.

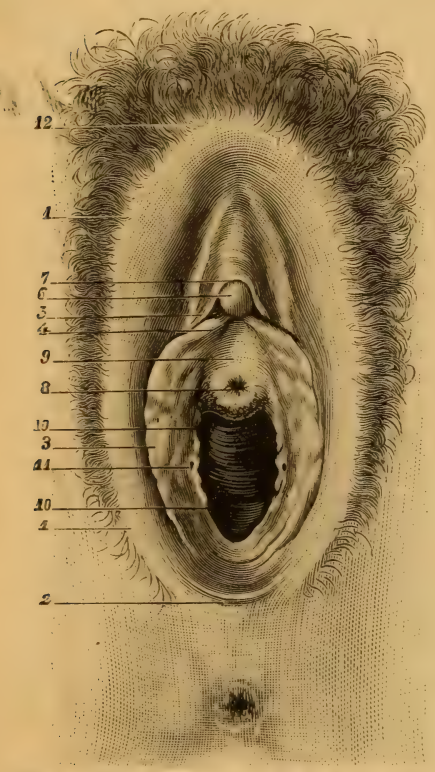


FIG. 4.—Vulva of a woman who has borne children. 1, labium majus; 2, fourchette; 3, labium minus; 4, inferior layer passing beneath the clitoris; 5, upper layer forming the prepuce; 6, clitoris; 7, prepuce; 8, meatus urethræ; 9, vestibule; 10, orifice of the vagina, showing lower portion of the vaginal canal; 11, orifice of the gland of Duverney; 12, mons Veneris. (Sappey.)

The *orificium vaginæ* differs greatly, both as to size and appearance, in virgins, in women accustomed to sexual intercourse, and in those who have borne children.

In virgins (*vide* Fig. 1) the anterior extremity of the vagina terminates in a thin membrane, termed the *hymen*, which projects between the labia minora. The mucous membrane of the inner surface of the hymen is continuous with that of the vagina; the outer surface is covered by an extension of the mucous covering of the vulva. The space between the two mucous surfaces contains blood-vessels, connective tissue, and

a few muscular fibers derived from the vaginal walls.* The vaginal orifice, which is therefore in virgins identical with that of the hymen, has usually a crescentic shape, with its concave border looking toward the urethral orifice, so that a small opening is left anteriorly for the escape of the menstrual fluid. There are, however, a number of other less common varieties, of which the following are the most important: 1. The hymen annularis, with a small central opening. 2. The hymen cribriformis, with a number of small openings. 3. The hymen imperforatus, which completely occludes the vagina, and occasions retention of the menses. 4. The hymen fimbriatus, from its resemblance to the fringed extremity of a Fallopian tube. This variety possesses medico-legal importance, from the possibility of its being mistaken for a normal ruptured hymen.

The thin tissues which constitute the hymen are usually lacerated by the first complete coitus. Laceration, however, is not, in all cases, the necessary result of sexual intercourse. A young girl, nineteen years of age, at one time under treatment for amenorrhœa in the uterine wards of the Bellevue Hospital, possessed a perfect hymen, the opening of which was of the ordinary size, yet so distensible was its tissue that a medium-sized (one inch) Fergusson speculum was repeatedly introduced, for purposes of exploration, without in the slightest degree affecting its integrity. Hyrtl mentions a specimen of the female genitalia preserved in Meckel's museum, at Halle, where the hymen is perfect, though the woman had given birth to a seven-months child.†

We are indebted to Schroeder for having pointed out that the fleshy eminences, known as the carunculæ myrtiformes, are the result of child-bearing, and not, in the rule at least, of sexual intercourse. Coitus simply causes a solution in the continuity, at one or more points, of the free border of the hymen. The pressure of the child's head, however, during labor causes necrosis and sloughing of the heretofore persistent though lacerated hymen, of which, subsequently, the familiar, isolated elevations of mucous tissue about the vaginal orifice furnish the only visible traces.‡ My own experience is entirely confirmatory upon this point. In the examination of young nulliparous prostitutes, who enter the Bellevue Hospital for uterine disorders, I have always found a torn hymen, but, in no case, carunculæ myrtiformes.

With the destruction of the hymen the *orificium vaginæ* is bounded by the labia minora and the vestibule.

* *Vide* Budin, Recherches sur l'hymen et l'orifice vaginale, Publication du progrès médicale, 1879.

† Hyrtl, Handbuch der topographischen Anatomie, Wien, 5te Auflage, Bd. ii, p. 162.

‡ Schroeder, Schwangerschaft, Geburt, und Wochenbett, Bonn, 1867, p. 6.

The Vagina.—The vagina is a membranous canal, connecting the uterus with the external parts of generation. It runs in an oblique direction forward from its attachment at the cervix to its orifice at the vulva. When not artificially dilated, its anterior and posterior walls are in contact with each other. The length of the vagina, owing to its extraordinary distensibility, is usually greatly over-estimated. Admit-

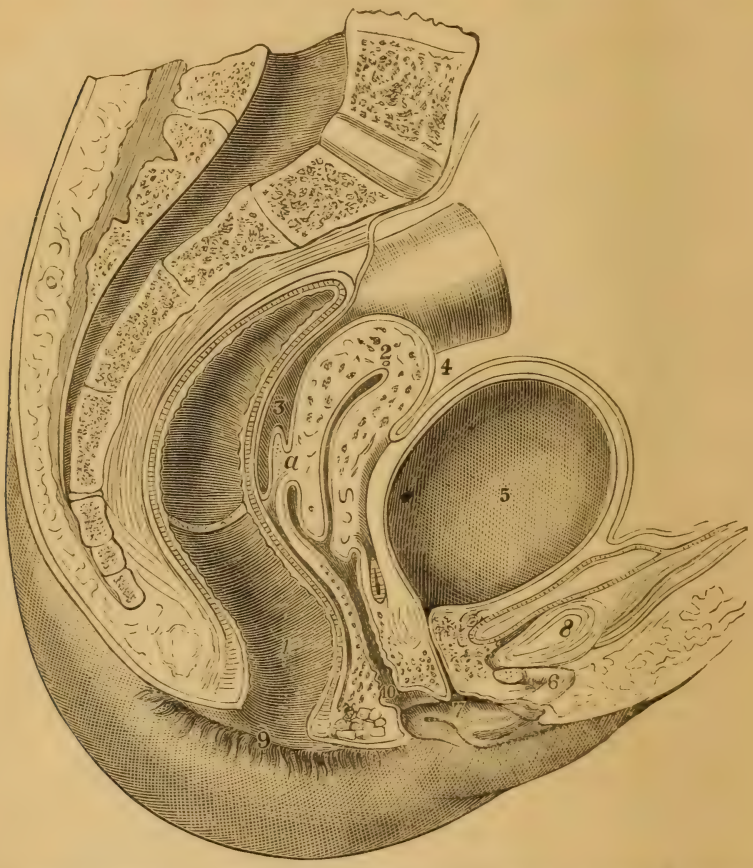


Fig. 5.—Section through the female pelvis (diagrammatic). 1, rectum; 2, uterus; 3, excavatio recto-uterina (cul-de-sac of Douglas); 4, excavatio vesico-uterina; 5, bladder; 6, clitoris; 7, urethra; 8, symphysis; 9, sphincter ani; 10, vagina; 11, connective-tissue layer. (Kohlrausch modified by Spiegelberg.)

ting considerable variations, dependent upon weight, position, etc., of the uterus, two and a half inches for the anterior, and a little over three inches for the posterior wall may be accepted as fair average measurements.* The vagina is placed between the rectum and bladder, and is more or less intimately connected with both those organs. In its upper fifth, the vagina is separated from the rectum by the *cul-*

* Luschka, Die Anatomie des menschlichen Beckens, Tübingen, 1864, p. 383.

PLATE I.

Section through pelvic organs of multipara, *ad naturam*. (Freund.) 1, Uterus; 2, vagina; 3, bladder; 4, excavatio recto-uterina; 5, excavatio-vesico-uterina; 6, fornix vaginæ; 7, external os; 8, internal os; 9, uterine cavity, with mucous lining; 10, septum urethro-vaginale.

de-sac of Douglas. From thence downward, the rectum and vagina form a common partition, the *septum recto-vaginale*. Above the pelvic floor a layer of connective tissue continuous with the pelvic fascia unites the rectum and vagina together. Below the pelvic floor the union of the two organs is immediate. Luschka limits the term "septum recto-vaginale" to this lower half of the common wall.*

The upper half of the anterior vaginal wall is attached to the bladder by means of loose connective tissue, while the lower half is inseparable from the tissues about the urethra. The partition thus formed between the urethra and vagina is termed the *septum urethro-vaginale*.

The *fornix*, as the upper part of the vagina is termed, encircles the vaginal portion of the cervix in such a way as to extend at least twice as high upon its posterior as upon its anterior aspect. The vaginal walls, when not distended artificially, are directly applied to the vaginal portion of the cervix.

The *structure* of the vaginal walls is not identical in all parts of the canal. In the upper portion the internal surface is nearly smooth, and the walls measure from a half a line to a line in thickness. They are composed of a mucous membrane, a muscular coat, and an external connective-tissue sheath, or layer. The latter is highly elastic, and affords support to the vaginal blood-vessels. The muscular fibers, which are of the involuntary variety, run in both a longitudinal and transverse direction, and are so interwoven together that a dissection into distinct strata is impossible.

The connective-tissue and muscular layers gradually increase in thickness as they approach the vaginal orifice. A circular bundle of voluntary fibers, the *sphincter vaginæ* of Luschka, surrounds the lower extremity of the vagina and urethra. The contraction of this sphincter not only acts upon the vaginal orifice, but likewise serves to close the urethra by compressing it against the septum urethro-vaginale.†

The *vaginal columns* are two thickened ridges, which occur in the median line, upon the anterior and posterior walls, at the lower portion of the vagina. The anterior column is more prominent, in the rule, than the posterior. It is often divided into two portions by a longitudinal furrow. In these thickened ridges the muscular fibers possess a trabecular arrangement and inclose offshoots from the venous plexus. The columns thus present a cavernous structure. They are not, however, endowed with erectility. When turgid with blood, they serve to close the vagina, but the resistance they offer, like that afforded by a filled sponge, is easily overcome.‡ The mucous membrane covering the columns is greatly thickened, and abundantly supplied with vessels.

* Luschka, Die Anatomie des menschlichen Beckens, Tübingen, 1864, p. 384.

† *Ibid.*, p. 387.

‡ Henle, Handbuch der Eingeweidelehre des Menschen, Braunschweig, 1866, p. 450.

The vagina is likewise furnished with transverse ridges (*cristæ*, not *rugæ*—they are not wrinkles), which are more fully developed upon the anterior than upon the posterior wall. In virgins these ridges possess a nearly cartilaginous consistence. Any relaxing agency, such as chronic catarrh, child-bearing, and the like, serves to efface them, and render the vagina smooth.

The mucous membrane of the vagina is covered with numerous vascular papillæ, which, under certain conditions, especially those pertaining to pregnancy, may reach such a degree of development as to communicate to the finger a distinctly granular sensation.

Though the secreting glands of the vagina * are few in number, it is covered, even in periods of repose, with a thin layer of acid mucus. Under sexual excitement, and during menstruation or pregnancy, the amount of this secretion is largely increased.

The hypogastric, the uterine, the vesical, and the pudendal *arteries* all send branches to the vagina. The pulsations of the uterine artery may sometimes be felt through the upper part of the vaginal walls. During pregnancy these pulsations are always so distinctly marked as to constitute a good inferential sign of that condition.

The *veins* form a close plexus around the vagina. Like all the pelvic veins, they are without valves, and are therefore peculiarly subject to stasis from anything that interferes with the return circulation. Blood-stasis, with enlargement of the vaginal veins, communicates a deep-purple color to the vagina. As the requisite conditions are fulfilled during gestation, Jacquemin and Kluge include this coloration of the vagina, which they compared to wine-lees, among the signs of pregnancy. It occurs, however, though perhaps to a less intense degree, in prolapsus uteri, in cases of pelvic tumors, and the like. As free intercommunication exists between the vaginal plexus and the plexuses distributed to the pudendum, the rectum, the bladder, and the uterus, a disturbance in the circulation of any one of these organs is necessarily attended with some degree of circulatory disturbance in all the contiguous organs.

The general relations of the external and internal organs of generation are admirably given in Fig. 6, which we have borrowed from Beigel.† It represents the complete generative system of a virgin (natural size).

II. The Uterus, Fallopian Tubes, and Ovaries.

The Uterus.—The uterus in the virgin differs somewhat in shape and size from that of a woman who has borne children. The follow-

* The occasional presence of glands in the vagina has been demonstrated by Preuschen. *Vide* Virchow's Archiv, 1877, vol. lxx, p. 111.

† Beigel, Die Krankheiten des weiblichen Geschlechtes, Erlangen, 1874, Bd. i, p. 23, Fig. 2.

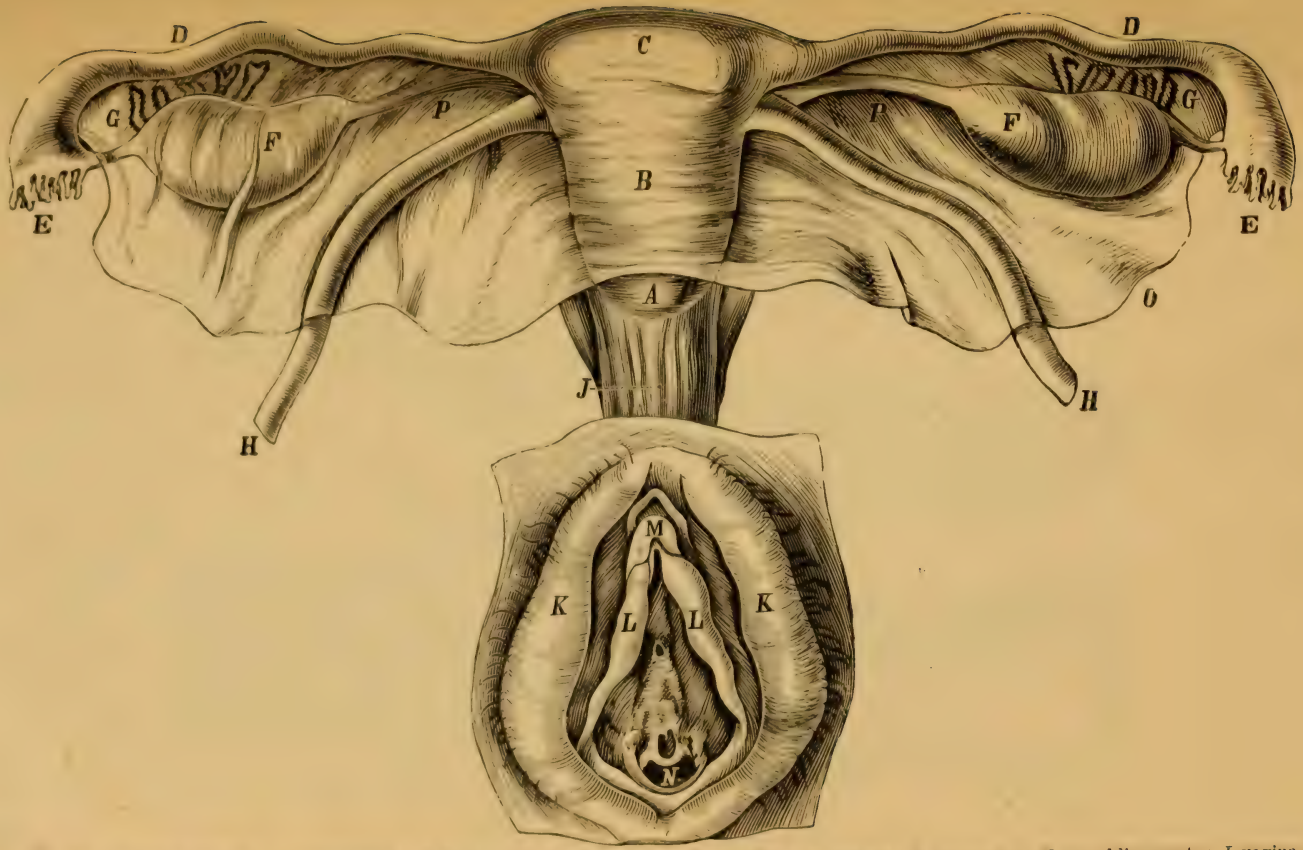


FIG. 6.—*A*, portio vaginalis ; *B*, corpus uteri ; *C*, fundus ; *D*, Fallopian tubes ; *E*, fimbriæ ; *F*, ovaries ; *G*, parovaria ; *H*, round ligaments ; *J*, vagina ; *K*, labia majora ; *L*, labia minora ; *M*, clitoris ; *N*, hymen. (Beigel.)

ing description is intended to apply to the nulliparous uterus only: In outward form the uterus has been compared to an inverted, wide-necked flask. It is flattened antero-posteriorly. Its average length is in the neighborhood of two and a half inches, though its dimensions vary to a very considerable extent. It is divided by a tolerably well-

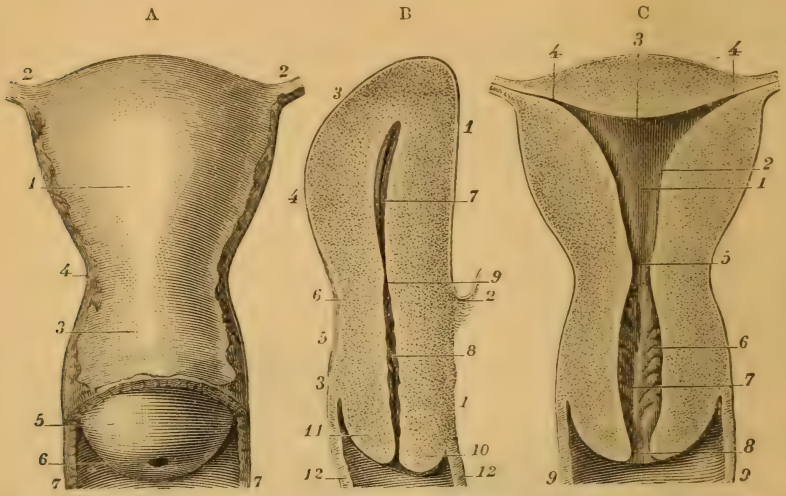


FIG. 7.—Virgin uterus. A, anterior view; B, median section; C, lateral section. (Sappey.) A, 1, body; 2, 2, angles; 3, cervix; 4, site of the os internum; 5, vaginal portion of the cervix; 6, external os; 7, 7, vagina. B, 1, 1, profile of the anterior surface; 2, vesico-uterine cul-de-sac; 3, 3, profile of the posterior surface; 4, body; 5, neck; 6, isthmus; 7, cavity of the body; 8, cavity of the cervix; 9, os internum; 10, anterior lip of the os externum; 11, posterior lip; 12, 12, vagina. C, 1, cavity of the body; 2, lateral wall; 3, superior wall; 4, 4, cornua; 5, os internum; 6, cavity of the cervix; 7, arbor vitæ of the cervix; 8, os externum; 9, 9, vagina.

defined constriction into two parts of nearly equal length. The upper, larger portion possesses an anterior, flattened, and a posterior, convex surface. It is limited by three borders. The upper border is moderately convex. The lateral borders are convex above and concave below. The Fallopian tubes pass into the uterus at the junction of the upper and lateral borders. The width of the uterus at this point is about one inch and a half. The lower portion has a spindle shape, and measures about a half-inch in its widest diameter.

All the lower, spindle-shaped portion of the uterus is termed the *cervix*, or neck. The portion of the uterus comprised between the neck and the Fallopian tubes is called the *corpus*, or body. The segment situated above the Fallopian tubes is distinguished as the *fundus*.

The lower extremity of the cervix projects freely into the vagina, and forms the *portio vaginalis*, the vaginal portion. It possesses a transverse aperture, measuring from a half a line to two lines in width, termed the external orifice, or sometimes the *os tincæ*, from a fancy of the anatomists that it resembled the mouth of a tench. The external orifice is bounded by two thick lips, of which the anterior is absolutely

longer than the posterior. As, however, the distance from the external orifice to the vaginal insertion is about half as great anteriorly as posteriorly, a sensation is communicated to the finger, when an examination is made *per vaginam*, as though the anterior lip were really the shorter of the two. This absolute superior length of the anterior lip, combined with the natural oblique direction of the uterus, causes the external orifice to look nearly directly backward, a fact which is readily recognized when the organs are examined *in situ* by means of a Sims's speculum.

Upon lateral section, the uterus is found to be provided with a cavity, in which the upper portion or cavity of the body is to be distinguished from the lower portion or canal of the cervix. The *cavity of the body* presents a triangular shape with convex borders. The two upper angles communicate by a small opening, hardly large enough to admit a fine bristle, with the canal of the Fallopian tubes. At the lower angle is situated the *os internum*, a circular orifice, large enough to admit a uterine sound, which forms the internal anatomical limit between the body and the cervix. The *canal of the cervix* has a fusiform shape, and is included between the internal and external orifices already described. Its inner surface is characterized by two longitudinal ridges, occupying the anterior and posterior walls, from which

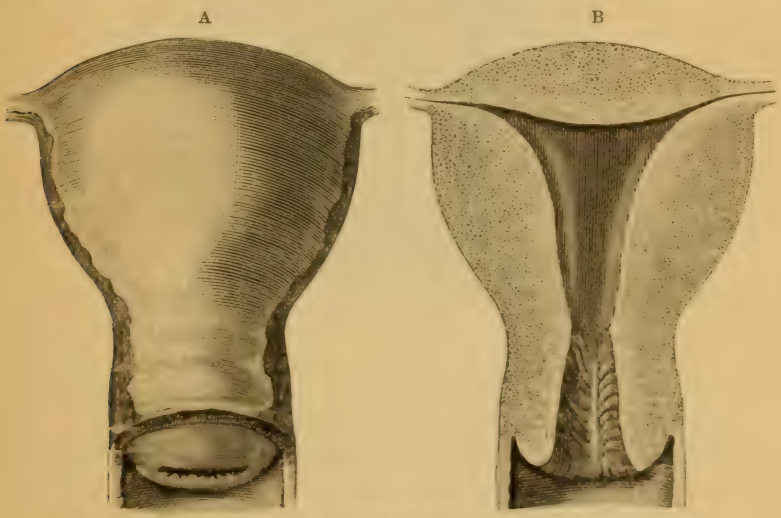


FIG. 8.—A, multiparous uterus, anterior surface; B, uterine cavity. (Sappey.)

branching processes extend obliquely upward, giving rise to an appearance which justifies the title—*arbor vitæ uterina*.

In women who have borne children, the uterus measures three inches in length, of which nearly two inches belong to the body and one to the cervix. There is increased convexity of the fundus. The distance

between the insertions of the Fallopian tubes measures over two inches. The width of the cervix, at its junction with the body, measures one inch. The uterus thus assumes a pyriform shape. The cavity of the uterus loses its triangular character, and assumes a more ovoid appearance. The external orifice no longer forms a smooth transverse depression, but its edges, lacerated by childbirth, communicate the impression of a rounded, puckered surface.

When a profile section is made through a perfectly healthy unimpregnated uterus, its walls are found in actual contact. A cavity does not, therefore, naturally exist.

The uterus is so situated in the pelvic cavity as to possess a large degree of mobility. Its lower extremity projects, as we have seen, into

FIG. 9.—Virgin uterus opened posteriorly, showing at *A*, *A'*, the os internum; at *O*, *e*, os externum; *P*, peritoneal folds. (Bandl.)

the vagina. The supra-vaginal portion of the cervix is attached anteriorly to the walls of the bladder. That portion of the uterus which extends freely into the pelvic cavity is covered by a reflection of the peritonæum, precisely as though the uterus had been pushed from below upward into the peritoneal sac. Thus the peritonæum covers the uterus anteriorly and posteriorly. Its two surfaces meet at the lateral borders of the uterus, and thence spread outward to the ilia of the respective sides. These peritoneal folds divide the pelvic cavity into two nearly equal halves, and are termed the *ligamenta lata*, or broad ligaments.

Two peritoneal folds, containing a few contractile fibers derived from the muscular tissue of the uterus, pass forward from the uterus

to the bladder—the *plicæ vesico-uterinæ*. These folds form the sides to a space, limited anteriorly and posteriorly by the bladder and uterus, termed the *excavatio vesico-uterina*.

Upon the posterior surface, the peritonæum descends down not only over the entire supra-vaginal portion of the uterus, but over that portion of the vagina which covers the posterior lip of the intra-vaginal portion. Thence it curves upward, and becomes continuous with the peritoneal investment of the rectum. Thus a deep *cul-de-sac* is formed between the uterus and the rectum, known as the *excavatio recto-uterina*, or *cul-de-sac of Douglas*. Two lateral folds of peritonæum likewise pass from the uterus to the rectum, which form sides to this space, the *plicæ recto-uterinæ*. These folds inclose in their

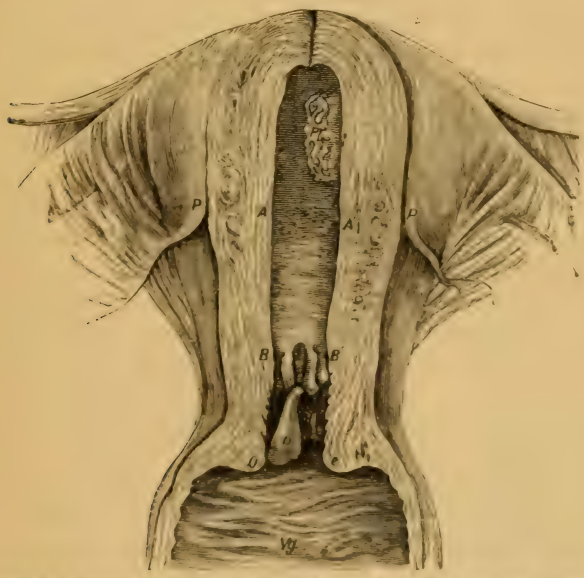


FIG. 10.—Uterus of a woman who has borne children. *A*, *A'*, the portion of the uterine cavity corresponding to the peritoneal folds. *P*; *B*, *B'*, os internum; *O*, *e*, os externum. (Bandl.)

free borders contractile muscular fibers, derived from the uterus and vagina. The plicæ recto-uterinæ pass backward, near the rectum, to the neighborhood of the second sacral vertebra. As the muscular fibers they contain were believed by Luschka to fulfill the function of maintaining the uterus in a state of normal anteversion, he proposed that they should be termed the *retractores uteri*. In Figs. 9 and 10, copied from Bandl, it will be noted that in the virgin uterus the upper borders of the peritoneal folds which bound laterally the *cul-de-sac* of Douglas leave the uterus at a point corresponding very nearly to the site of the os internum; whereas, in the uterus of women who have borne children, the os internum is situated at a considerable

distance below the folds, a difference which Bandl believes to be due to an expansion of the upper portion of the cervical canal by the growth of the ovum during pregnancy, the expanded portion thereafter forming permanently an addition to the uterine cavity.

The peritonæum covering the uterus is an exceedingly delicate membrane. Over the body and fundus of the uterus, both front and rear, it adheres intimately to the muscular tissues, while below the level of the recto-uterine folds, where the subperitoneal connective tissue is more abundant, separation is easily effected.

Though it may be proper to speak, in a general way, of the uterus as occupying a position coincident with the axis of the superior pelvic strait, it must be borne in mind that, in reality, its position is largely influenced by the neighboring organs. Thus, a full bladder pushes the fundus backward. A full rectum shoves the cervix forward. When bladder and rectum are both evacuated, the resiliency of the muscular fibers in the recto-uterine folds produces a limited amount of anteversion. Marked degrees of anteversion or anteflexion following the evacuation of the bladder are abnormal, and are due either to fixation of the cervix resulting from inflammatory changes in the parametrium, to increased size of the uterus, or to the loss of the muscular *tonus*.

The uterus is composed of muscular fibers of the unstriped variety, arranged in bundles and united together by delicate processes of connective tissue. In the non-gravid, but more distinctly in pregnant and puerperal, uteri the arrangement of the muscular fibers in three layers is indicated, though the layers are not absolutely separable from one another.

1. The *superficial layer* covers the anterior and posterior surfaces of the uterus like a hood, while the sides are left free. It possesses a membranous thinness, and is intimately adherent to the peritonæum. Its fibers, a part of which are continuous with the longitudinal fibers of the external muscular layer of the Fallopian tubes, pursue an apparently circular course in the neighborhood of the tubes and a longitudinal direction near the median line.

The continuity of the outer layer is, however, broken by the insertions of the retractor muscles, and of the ovarian and round ligaments. The ovarian ligament is a broad band, measuring about an inch in length and a fifth of an inch in width, which passes posteriorly from the upper lateral portions of the uterus between the layers of the broad ligament to the ovary. The round ligament, a muscular bundle of rounded form, passes from the anterior uterine surface near the insertions of the Fallopian tubes between the peritoneal folds of the broad ligament and through the inguinal canal to the symphysis pubis, where its fibers terminate in the connective tissue of the mons Veneris. The round ligament is four to five inches in length, and in the unimpregnated condition, when the fundus is depressed below the pelvic

brim, runs in a curved direction upward, outward, and forward, to gain the inguinal ring.

2. The median layer constitutes the great bulk of the uterine walls. It is composed of longitudinal and transverse fibers which form an intricate interlacement, in the meshes of which are contained the vessels of the organ. In pregnancy the arrangement of muscular bundles in superimposed leaf-like plates or lamellæ is observable. These start in the fundus and body of the uterus from the peritonæum, to which they are firmly attached, and at first the fibers are in close proximity. They soon, however, split into bundles, which follow, in most cases, an oblique course downward and inward to the uterine mucous membrane. In the lower uterine segment, i. e., the inferior convex portion of the uterine cavity, which in pregnancy and childbirth is subjected to the distending influence of the presenting part, the muscular lamellæ—seven to ten in number (J. Veit)—are attached to the peritonæum by means of loose connective tissue. They send fibers in part to the connective tissue of the cervix, and in part to that which surrounds the upper vaginal walls.

3. The inner layer is of extreme tenuity. Its fibers pursue a spiroidal course around the orifices of the tubes. Between the latter and the internal os the fibers of the inner layer form on the anterior and posterior surfaces beneath the mucous membrane a triangular muscle, and extend downward into the cervix. During pregnancy the triangular muscles, owing to their fixation at the internal os, do not follow the expansion of the uterine cavity. The underlying transverse fibers are therefore exposed upon the lateral walls, a condition which persists, after involution is complete (Bayer).

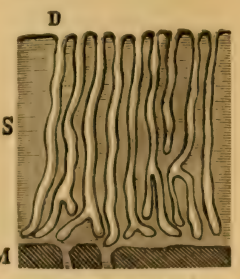


Fig. 11.—Section through the mucous membrane of a normal virgin uterus, magnified about forty diameters (Kundrat and Engelmann). S, mucous membrane; D, glands; M, muscular tissue belonging to the internal layer.

The cervical walls are composed mainly of connective tissue. The muscular structures of the cervix are derived from the lamellæ of the lower segment, from the inner layer of the uterus, and from the fibers which accompany the distribution of the vessels.

Upon the outer surface of the cervix, just at the point of the vaginal attachment, there is a well-developed layer of transverse muscular fibers. Circular vessels, imbedded in a loose-meshed connective tissue containing wide lymphatic spaces, surround the cervix at the same point. Thus a ridge is formed, which is greatly augmented in size during pregnancy.

In the cervix, the connective tissue exists in the form of well-differentiated fibers of the ordinary variety. In the body of the uterus, a similar loose-meshed, wavy connective tissue is found in the external

layer, where it sends processes between the muscular bundles, and surrounds the vessels. In the median layer, rings of connective tissue accompany the vessels, while fibers of the finest description penetrate between the muscular bundles. Fine fibers, of a like character, but more abundant, are found in the inner muscular stratum, whence they pass directly into the connective tissue of the mucous membrane.

The mucous membrane of the uterus is divided into that lining the body and that which lines the cervical portion, between which characteristic differences of structure exist.

The mucous membrane of the body is smooth and soft. At the fundus and upon the sides it measures about $\frac{1}{25}$ of an inch in thickness, but is thinner in the vicinity of the tubes and the cervical portion. It is covered, under normal conditions, with a thin layer of transparent alkaline mucus. When examined with a magnifying-glass its surface presents a perforated appearance, due to the openings of the *uterine glands*. These glands are of the tubular variety, have a sinuous course, and are oftentimes divided below into two or three separate blind extremities. They extend, in the rule, through the entire thickness of the mucous membrane, and, in rare instances, penetrate into the muscular tissue of the uterus. They possess a delicate basement membrane, composed of spindle-shaped cells, which dovetail into one another like the endothelium of the capillaries and lymphatics.* They are lined by cylindrical cells which are said to possess ciliæ. The mucous membrane of the body of the uterus possesses an epithelium of the ciliated variety, which produces a current in the direction of the Fallopian tubes.†

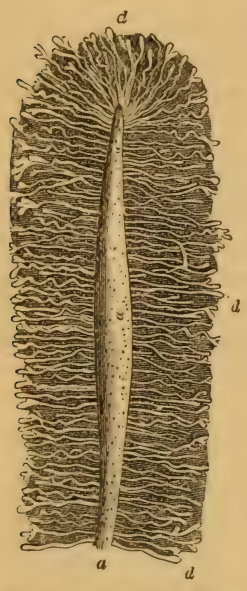


FIG. 12.—Section through uterus showing cavity, *a*, and glandular structures, *d*. (Weber.)

A very irregular capillary net-work, with delicate walls, extends between the glands, and passes near the free surface into venous radicles, which furnish during menstruation the source of venous hæmorrhage.

The intermediate space is filled up by a connective-tissue mesh-work, composed of fine processes and spindle-shaped cells, whose nuclei im-

* LEOPOLD, Die Lymphgefässe des normalen nicht schwangeren Uterus, Arch. f. Gynaek., Bd. vi, 1873, Heft 1, p. 33.

† V. STRICKER, Die Lehre der Geweben, Leipsic, 1871, art. Uterus, von Dr. R. CHROBAK, pp. 1173 *et seq.*

part to hardened specimens a granular appearance. Leopold * claims for this mesh-work the significance of lymph-sinuses. The close attachment of the mucous membrane to the muscular tissue is explained by the direct continuity of the connective tissues of the two structures.

The mucous membrane of the cervix is of a yellowish-red color, of a firm consistence, and possesses the penniform ridges already described. It is therefore readily distinguished, both by the eye and the touch, from the red, smooth, velvety structure of the mucous membrane lining the body. At the time of puberty it possesses a ciliated, cylindrical epithelium, which extends down to within from two to three lines of the os externum.† Simple gland-tubes, and glands with multiple *culs-de-sac*, are found upon the crests and sides of the ridges and upon those portions of the cervical canal in which ridges do not exist. These glands are, genetically considered, simple inversions of the mucous membrane, and are lined by ciliated epithelium. When the neck of one of these glands becomes obstructed, the secretion accumulates, and forms the straw-colored vesicles which have been termed the ovula of Naboth. Papillary structures, of clavate shape, are very numerous in the lower half or third of the canal. According to Lott,‡ a section through one of these papillæ is not to be distinguished from a section through one of the smaller folds of the arbor vitæ uterina. The cervical mucous membrane affords thus an extensive secretory surface, furnishing an alkaline mucus, which possesses important physiological functions in connection with conception, pregnancy, and labor.

The Fallopian Tubes.—The Fallopian tubes, as the history of their developments goes to demonstrate, are, strictly speaking, integral portions of the uterus. A glance at Fig. 14 will serve to make apparent the continuity between the tissues of the uterus and those of the Fallopian tubes. It will be noticed, too, that the canal of the latter communicates directly with the uterine cavity. The Fallopian tubes measure from three to four inches in length. They are included between the folds of the broad ligament at its upper border. As they pass outward from the uterus they follow a somewhat sinuous course, and gradually increase in width and thickness. The free extremity possesses an opening communicating with the abdominal cavity, the *ostium abdominale*, which is large enough to admit a small goose-quill (2″), whereas the uterine opening does not exceed $\frac{1}{25}$ of an inch in diameter. Henle designated the inner, narrower half, which runs a comparatively straight course, the *isthmus*, and the outer, sinuous, dilated portion the *ampulla* of the tube. A number of ragged, fringe-like processes surround the ostium abdominale, whence the name *fimbriated extremity of the tube*. These fringes received likewise from the mediæval anatomists the name

* *Op. cit.*, p. 47.

† Lott, Zur Anatomie und Physiologie der Cervix Uteri, Erlangen, 1872, p. 17.

‡ Lott, *l. c.*, p. 20.

morsus diaboli, from a supposed resemblance to the root of the scabiosa succissa, the peculiar appearance of which was ascribed by the super-

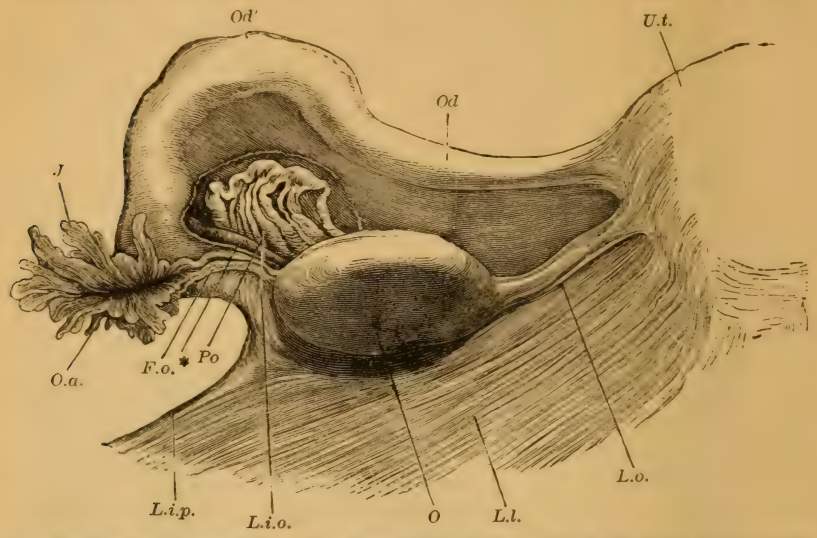


FIG. 13.—Posterior lateral view of the uterus (*U.t.*), with portion of lig. latum (*L.l.*), oviduct, and ovary. *Od*, isthmus; *Od'*, ampulla; *J*, infundibulum; *O.a.*, ostium abdominale; *F.o.*, fimbria ovarica; *O*, ovarium; *L.o.*, lig. ovarii; *L.i.o.*, lig. infundibulo-ovaricum; *L.i.p.*, lig. infundibulo-pelvicum; *Po*, parovarium. (Henle.)

stitious to a bite the devil gave it in a fit of anger at its beneficent action in the maladies that affect the human race.* One of the fim-

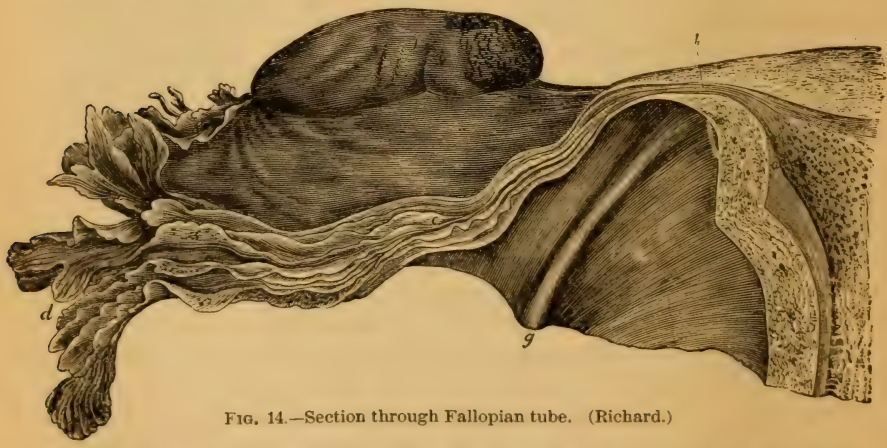


FIG. 14.—Section through Fallopian tube. (Richard.)

briæ (*F. o.*) is rather longer than the rest, and is attached to the outer angle of the ovary.

The *muscular walls* of the tubes are composed of unstriped fibers,

* HYRTL, Topographische Anatomie, Wien, 1865, Bd. xi, p. 210.

similar to those described as existing in the uterus. They are arranged in three layers: two, longitudinal, continuous respectively with the external and internal layers of the uterus; and one, circular, continuous with the circular fibers of the inner uterine layer. Galvanization of the tubes causes contractions of a vermicular character.

Between the muscular walls and the peritoneal covering there is a connective-tissue layer, which gives support to a rich plexus of blood-vessels.

FIG. 15.—Section through ampulla (thirty diameters). *a*, submucous tissue; *b*, muscular layer; *c*, serous coating; *d*, mucous membrane; *e*, *e*, vessels; 1, 1, little folds, resembling villosities when seen in profile; 2, 2, longitudinal folds of larger size, with numerous accessory folds; 3, 3, little folds, united together so as to form a sort of canalicular net-work. (Luschka.)

The *mucous membrane* of the tubes is extremely vascular, and has a ciliated epithelium, which produces a current in the direction of the uterus. It presents numerous longitudinal folds, which are much more complicated in the ampulla than in the isthmus. In the ampulla these folds possess an arborescent character, as may be seen in Fig. 15.

The Ovaries.—The ovaries are two flattened, nearly ovoid bodies, situated between the layers of the broad ligament. They measure from one to one and a half inch in length, from three fourths of an inch to an inch in breadth, and from a third to a half inch in thickness. Each ovary is connected with the uterus by a muscular band about an inch in length and a fifth of an inch in width, termed the *ligamentum ovarii*.

Previous to puberty the ovaries present a smooth surface, but after maturity they become uneven and corrugated from the enlargement, rupture, and cicatrization of the Graafian follicles.

Although the ovaries are said to be of ovoid shape, in reality one border is much more convex than the other. The comparatively straight border is attached to the posterior surface of the anterior layer of the broad ligament. The posterior layer of the broad ligament is reflected over the entire ovary, with the exception of the attached border, at which point the hilum, or opening, is situated, through which the spermatic vessels, which are included between the folds of the broad ligament, find entrance into the substance of the organ. Waldeyer * has shown that an abrupt change in the character of the epithelium from the pavement to the cylindrical variety takes place where the peritonæum reaches the hilum of the ovary. At this point, too, the connective tissue of the serous membrane ceases to form an independent layer, easily separable from the underlying tissues, but becomes lost in the stroma of the ovary.

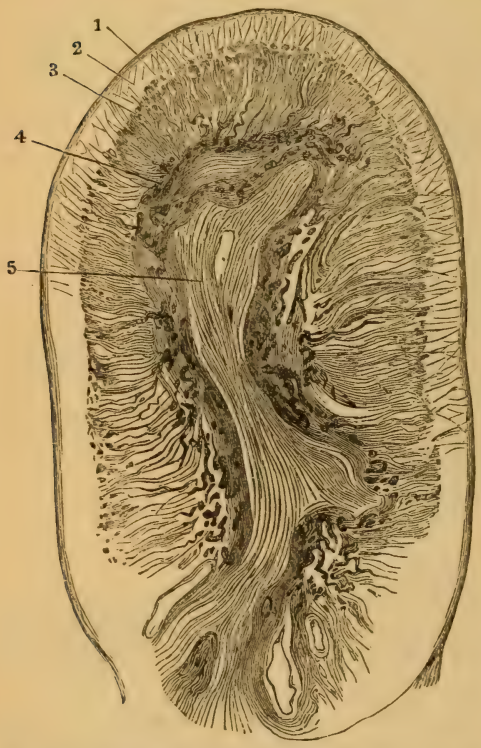


Fig. 16.—Longitudinal section of ovary from a person aged eighteen (eight diameters). 1, albuginea; 2, fibrous layer of cortical portion; 3, cellular layer of cortical portion; 4, medullary substance; 5, loose connective tissue between the firm layers of the medullary substance. (Henle.)

When the broad ligaments are removed from the body, and held as nearly as possible in the natural position, the convex border of the ovary looks downward. If the broad and ovarian ligaments are, however, put upon the stretch, the convex border rises and looks directly backward.

The ovary is found, upon section, to contain a fibrous stroma, the

* Waldeyer, Eierstock und Nebeneierstock. Stricker's Handbuch der Lehre der Geweben, p. 545. And for modification of Waldeyer's earlier views, *vide* Archiblast and Parablast, Bonn, 1883, p. 68.

arrangement of which can be best understood by reference to the accompanying excellent illustration from Henle.

Externally, the ovary is surrounded by a fibrous coating, the so-called *tunica albuginea*. In the first three years of existence, however, the albuginea is wanting. Even in a state of complete development, it can never be stripped off as a separate layer, but is always intimately adherent to the subjacent tissues.

Beneath the albuginea the parenchyma of the gland is further divided into an outer cortical and an inner medullary substance.

The *medullary substance* has a spongy texture, and is of a reddish color. It contains an abundance of blood-vessels, the branches of which pursue a spiral course. The *cortical substance* is of a grayish color. In it a multitude of small follicles, of the utmost functional importance, lie imbedded. The precise description of these follicles will be given in connection with the subject of ovulation. The stroma of the cortical substance is nowhere sharply distinguished from that of the medullary portion. The fibers of the stroma, for the most part, radiate from the center toward the circumference. Just underneath the albuginea, however, the connective tissue of the cortical substance presents a felted arrangement. This portion is termed in the illustration (Fig. 16) the fibrous layer, in contradistinction to the more central portion, which is largely composed, in the neighborhood of the vessels and the follicles, of round and spindle-shaped cells.

The Vessels of the Uterus and its Appendages.—The uterus receives its arterial supplies from the following sources: 1. The *arteria uterina hypogastrica*. This artery, as its name implies, is derived from the hypogastric. It first pursues a downward course to reach the vaginal fornix, where its pulsations may be felt during pregnancy. Thence it curves upward between the folds of the broad ligament, and follows a tortuous course along the lateral borders of the cervix and corpus uteri. It distributes small branches to the fornix vaginæ, and large ones to the uterus. The uterine branches are, in part, distributed to the surface of the uterus, and, in part, penetrate the muscular tissue, to form a thick capillary net-work immediately under the uterine mucous membrane. Of surgical interest is a circumflex branch, which unites the arteries of each side with one another. The situation of this branch is just at the junction of the cervix and body. During pregnancy other anastomotic branches are developed.* As the pregnant uterus is situated directly under the abdominal walls, the arterial murmurs are at certain points distinctly appreciable, and furnish the auscultatory sign of pregnancy improperly termed the "placental

* Hyrtl disputes the formation of anastomoses during pregnancy, and states that in the pregnant as well as in the non-pregnant uterus none but capillary communication exists between the arteries. Topographische Anatomie, Wien, 1865, Bd. ii, p. 194.

bruit." 2. The *arteria uterina aortica*, or internal spermatic artery. The origin of this artery is situated about two and a half inches above the bifurcation of the aorta. It pursues a serpentine course, and, in places, makes spiral turns, which are specially marked during pregnancy. It descends obliquely downward under the peritonæum to the cavity of the pelvis, and then ascends between the folds of the broad ligaments to reach, by its branches, the ovary, the Fallopian tube, and, by its main trunk, the side of the uterus, where it forms a direct communication with the art. uterina hypogastrica.

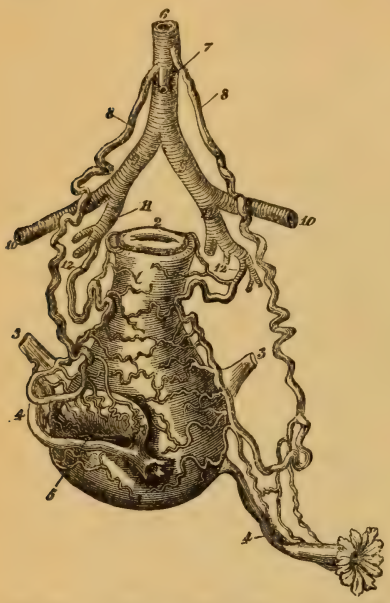


FIG. 17.—Arterial vessels in a uterus ten days after delivery; the uterus is turned forward, so as to present the posterior aspect. 1, fundus uteri; 2, vaginal portion; 3, 3, lig. teres; 4, 4, Fallopian tubes; 5, right ovary; 6, abdominal aorta; 7, art. mesenterica inf.; 8, 8, art. uterina aortica (spermatic arteries); 9, 9, art. iliaca communis; 10, art. iliaca ext.; 11, art. hypogastrica; 12, art. uterina hypogastrica. (Luschka.)

This communication between the aortic and hypogastric uterine arteries serves to maintain a continuous blood current during gestation. The situation of the uterine artery within the pelvic cavity, and its exposure to pressure, would render it, were it the sole source of blood-supply, an extremely unsafe dependence. It is well to note here, that when pressure is made upon the aorta, after childbirth, with a view to checking *post-partum* hæmorrhage, the manipulation fails to affect in any way the blood-stream which pours into the uterus from the aortic uterine branches.

The beautiful injections of Rouget * have demonstrated a peculiar disposition of the aortic uterine branches, as they penetrate the body of the uterus. Instead of dividing, as they branch, dichotomously, they break up, on reaching the vicinity of the Fallopian tubes, into from twelve to eighteen arterial tufts, of which each branch is twisted in spiral form. These tufts of vessels are so aggregated together as frequently to cover the angles of the uterus.

The *veins* of the *uterus* form a net-work, which traverses the uterine tissues in all directions. As their walls are intimately adherent to the muscular tissues of the uterus, they remain patulous upon section, and, when enlarged by pregnancy, are termed "sinuses." Rouget likewise describes twisted, tangled venous tufts, which often form spirals

* ROUGET, Recherches sur les Organes Érectiles de la Femme, Jour. de la Physiol., 1858, t. i, pp. 320 *et seq.*

like those described in the arteries. The same authority claims that the ultimate divisions of the arteries communicate with the venous sinuses by very fine vessels, measuring from $\frac{1}{250}$th to $\frac{1}{75}$th of an inch, instead of by capillary net-works.

The return-currents of the uterus empty into two venous plexuses:

1. The *plexus uterinus*. This plexus receives its blood from the uterus alone. It extends between the folds of the broad ligament, and empties into the hypogastric vein.

2. The *plexus pampiniformis*. The plexus pampiniformis derives its blood from the uterus, the Fallopian tubes, and ovaries. Its vessels combine to form a single trunk, the vena spermatica interna, which follows the course of the artery of the same name, and empties, on the left side, into the vena renalis, on the right into the vena cava.

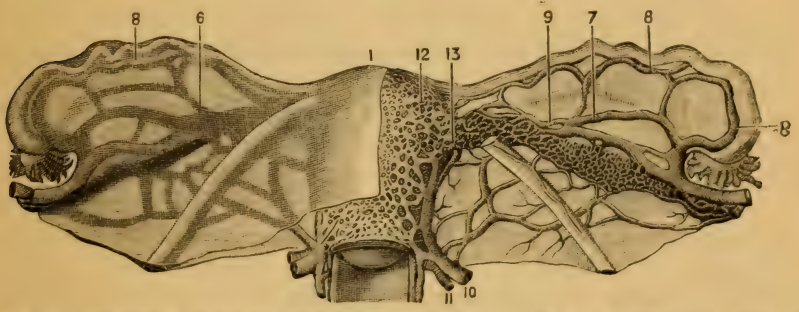


FIG. 18.—Uterine and utero-ovarian veins (plexus pampiniformis). 1, uterus seen from the front; its right half is covered by the peritonæum; upon the left half may be seen the plexus of utero-ovarian veins (internal spermatic); 6, utero-ovarian vessels covered by peritonæum; 7, the same vessels exposed; 8, 8, 8, veins from the Fallopian tube; 9, venous plexus of the hilum ovarii; 10, uterine vein; 11, uterine artery; 12, venous plexus, covering the borders of the uterus; 13, anastomoses of the uterine with the utero-ovarian vein (int. spermatic). (Sappey.)

The *arteries* of the *ovary* are derived, as we have had occasion to notice, from the internal spermatic, penetrate the medullary substance, at the hilum ovarii, and describe a spiral course. The arterial branches anastomose within the ovary, and form an interlacement, including spaces, which become smaller and smaller as the surface of the gland is approached. The veins start as radicles from the capillaries, then rapidly enlarge, and present a varicose appearance. By their anastomoses they form a plexus, which includes spaces of very irregular size. The blood is then taken up by venous trunks, which run parallel to the arterial branches, and terminate finally in the internal spermatic vein (termed by Sappey, Fig. 18, the utero-ovarian vein).

Upon the basis of the foregoing description * Rouget draws a parallel between the structures of the penis and those of the corpus uteri, and claims identity between the two organs. One feature, however, of

* ROUGET, Recherches sur les Organes Érectiles de la Femme, Jour. de la Physiol., t. 1, pp. 338 *et seq.*

the erectile tissue, as generally understood, is wanting in the uterus, viz., a dense, fibrous sheath, a tunica albuginea, inclosing the erectile organ, limiting the degree of its distention and enhancing its turgidity.

As experimental proof that the uterus possesses erectile properties, Rouget has shown that, when an injection is forced by the spermatic artery, in the dead subject, so as completely to distend the vessels of the body of the uterus, the latter becomes elevated in the pelvis, and makes a movement similar to that performed by the penis during venereal excitement.

It is, however, obvious that the forcible distention of the vessels of a flaccid uterus, in which the muscular walls are deprived of their normal *tonus* by death, does not necessarily represent the phenomena produced during life by the turgescence resulting from either ovulation or the sexual orgasm. Unfortunately, so far as the body of the uterus is concerned, the difficulties in the way of direct observation upon the living subject have hitherto rendered the settlement of this point impossible.

With regard to the cervix uteri, we have physiological as well as anatomical reasons for admitting a certain kind of erectility. To be sure, a tunica albuginea is wanting. It is, therefore, not an ideal erectile organ. But it is among the occasional unpleasant experiences of gynæcological practice that a simple digital examination, made for the purpose of a diagnosis, may evoke the venereal orgasm. Precise observations as to the phenomena presented by the accessible portion of the uterus during the orgasm have been furnished by Wernich,* Litzmann,† and in one remarkable case by Beck,‡ which leave very little doubt that strong erotic excitement is attended by a rigidity of the cervix, which produces an impression upon the fingers similar to that imparted by the glans of the male organ during erection.

The following anatomical peculiarities of the cervix uteri are furnished by Henle: The walls of the vessels (arteries, capillary branches, and veins) are characterized by an extraordinary development of the circular layer of muscular fibers. For instance, in vessels measuring from $\frac{1}{2500}$ to $\frac{1}{600}$ of an inch, the diameter of the bore is scarcely one third the diameter of the entire vessel. The arrangement of the vessels is likewise peculiar. In the labia uterina, especially within the muscular tissues, small branches pass directly down to the mucous surface. These branches pursue an undulatory course, are parallel, and run at nearly equal distances from one another. Just beneath the mucous surface in like manner the veins arise and make their way upward parallel to the arteries, and with the same orderly arrangement.

* Wernich, Die Erectionsfähigkeit des unteren Uterus-Abschnittes, Beitr. zur Geburtsh. und Gynaek., Bd. i, p. 296.

† Wagner's Handwörterbuch der Physiologie, Bd. iii, p. 53.

‡ Beck, How do the Spermatozoa enter the Uterus? Am. Jour. Obst., Nov., 1874.

The capillary connections between these veins and arteries are situated just beneath the epithelium, where they form looped projections into the papillæ. In the plicæ palmatæ the general direction of the vessels is likewise perpendicular to the surface. In commenting upon these facts, Henle remarks that there is nothing in the situation of the arterial walls that would call for their special development, as they are not particularly exposed to external pressure. "Where, however," he says, "extraordinary means are employed in maintaining contraction, extraordinary relaxation and dilatation are possible." He therefore premises, as at least probable, "that the changing degrees of contractility in the finer vessels may serve to impart a sort of capacity for erection, or, at least, turgescence, to the cervical and vaginal portion" —an anatomical deduction sustained, as we have seen, by physiological observation.

A similar attempt on the part of M. Rouget to constitute an erectile organ out of the ovary is disposed of by Sappey as follows: "Erectile tissue is formed by large, short, anastomosing capillaries, supporting muscular trabeculæ, and into which open the ultimate divisions of the arteries; but in the bulb (the vascular portion of the ovary) there are neither dilated capillaries, nor areolæ, nor trabeculæ. The analogy signalized by M. Rouget is therefore much more apparent than real." *

The Nerves.—The nerves of the uterus are derived from the gangliated cords of the sympathetic system, through which important connections are formed with all the abdominal viscera. Just at the bifurcation of the aorta there is a broad band of nerve tissue termed the *plexus uterinus magnus*, formed by the coalescence of filaments from the spermatic ganglia (two pairs of ganglia, situated upon each side of the inferior mesenteric artery) and filaments derived from that portion of the aortic plexus which is distributed mainly to the superior mesenteric artery (plexus mesentericus superior, Frankenhaeuser).† About an inch and a half below the bifurcation of the aorta it divides into two strands, the *plexus hypogastrici*, which pass right and left around the rectum to the uterus and upper portion of the vagina. The hypogastric plexuses receive nerve branches from the lower lumbar and three upper sacral ganglia. Upon the sides of the rectum they divide each into two portions, of which the smaller passes directly to the posterior and lateral walls of the uterus, while the larger contributes to the formation of the cervical ganglion.

The cervical ganglion (Frankenhaeuser) is not, according to Jastreboff,‡ a separate organ, but a large plexus composed of many ganglia,

* Traité d'Anatomie, Paris, 1874, vol. iv, p. 691.

† Frankenhaeuser, Die Nerven der Gebärmutter, Jena, 1867.

‡ Jastreboff, Anatomy of the Ganglion Cervicale Uteri, London Obst. Trans., vol. xxiii, p. 266.

which measures during pregnancy two inches in length by one and a half inch in breadth. It is formed by the concurrence of filaments from the hypogastric plexus, the three upper sacral ganglia, and the

FIG. 19.—Nerves of the uterus. *A*, plexus uterinus magnus; *B*, plexus hypogastricus; *C*, cervical ganglion. 1, sacrum; 2, rectum; 3, bladder; 4, uterus; 5, ovary; 6, extremity of Fallopian tube. (Frankenhaeuser.)

first, second, and third sacral nerves. The cervical ganglion supplies the entire uterus, and especially the cervical portion, with nerves. Examined with the naked eye, these nerves are soon lost sight of as they penetrate the walls of the uterus, but their ultimate filaments have been traced by Frankenhaeuser, in microscopic preparations, to the muscular element, where they apparently terminate in the nucleus of the fiber-cell.

The Lymphatics.—We have already had occasion to notice the prob-

able existence of lymph-spaces in the uterine mucous membrane. In the muscular tissue of the uterus, lymph-spaces are found in the delicate connective tissue which unites the muscular bundles together. Regular lymphatic vessels are found in the connective tissue which accompanies the arterial trunks into the uterine parenchyma. A net-work of lymphatic vessels, with dilated and constricted portions, and provided with valves, exists beneath the serous coat. The lymph-spaces of the uterine mucous membrane communicate, by funnel-shaped depressions, with the lymph-spaces and lymphatics of the muscular strata. Just beneath the external muscular layer, upon the lateral borders of the uterus, are large receiving vessels, into which empty the lymphatics from both the subserous and uterine vessels. The lymphatics of the cervix pass to the glands of the pelvic cavity, while those of the border and fundus follow the course of the plexus pampiniformis to form connections with the lymphatics of the lumbar region.*

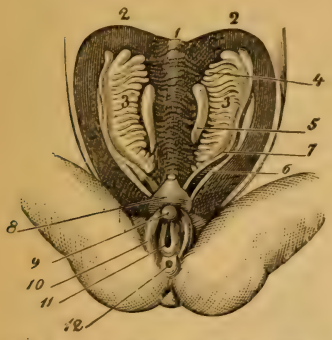


FIG. 20.—Rudimentary sexual organs. The internal organs represented at the seventh week of fetal life; the external organs belong to a later period. 1, spinal column; 3, 3, Wolffian bodies; 5, glands destined to become the ovaries in the female, the testicles in the male; 6, Wolffian duct; 7, filaments of Müller; 8, bladder; 9, tubercle, forming the rudiment of either the clitoris or penis; 10, folds destined to form the labia majora (in the male the scrotum); 11, sinus uro-genitalis; 12, anus. (Luschka.)

DEVELOPMENT OF THE FEMALE GENERATIVE ORGANS.—Three connected structures make their appearance on either side of the spinal column, at an early period of fetal existence, which need to be understood by those who would gain a clear idea of the developed organs of generation in the female. These structures are the Wolffian bodies, the ducts of Müller, and the rudimentary organs which are destined at a more advanced period to become the ovaries.

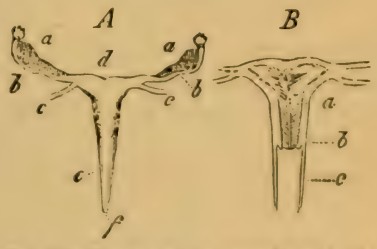


FIG. 21.—Uterus and its appendages in the fœtus at the end of the fourth month (natural size). *A*, external view; *a*, *a*, ovaries, relatively large, nearly as long as the oviducts; *b*, *b*, the Fallopian tubes (oviducts); *c*, *c*, round ligaments; *d*, uterus; *e*, vagina; *f*, vaginal orifice. *B*, interior view; *a*, rami of the arbor vitæ, extending to the fundus of the uterus; *b*, vaginal portion of uterus; *c*, vagina. (Courty.)

The **Wolffian bodies** are oblong glandular structures, temporary in character, which are thought to perform, in the embryo, the excretory function of the kidney. They

* LEOPOLD, Die Lymphgefässe der normalen nicht schwangeren Uterus, Arch. f. Gynæk., Bd., vi, Heft 1, pp. 1 *et seq.*; LUSCHKA, Die Anatomie des menschlichen Beckens, Tübingen, 1865, p. 378.

possess ducts, situated at the sides, which converge together below the Wolffian bodies to empty into the sinus uro-genitalis.

Two organs, destined to become the *ovaries*, make their appearance upon the inner side of the Wolffian bodies. They possess at first an elongated, but subsequently assume a more oval appearance.

The **ducts of Müller** are secondary formations, and are produced by an inversion of the peritoneal epithelium, beginning near the anterior end of the Wolffian body and thence extending downward parallel to the Wolffian ducts. (Kölliker.) Below they pass spirally forward, where they meet in the median line, to descend together to the sinus

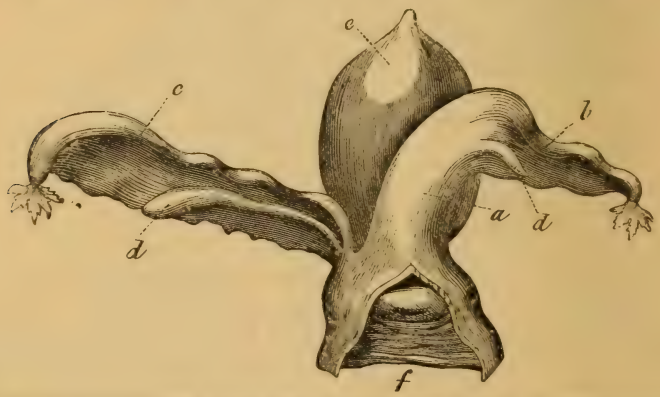


FIG. 22.—Uterus unicornis from a young child, posterior aspect (Pole). *a*, uterus unicornis, left half of uterus undeveloped; *b*, right Fallopian tube; *c*, left Fallopian tube, exceptionally present; *d*, *d*, ovaries; *e*, bladder. (Courty.)

uro-genitalis. By the eighth week the lower portions of the filaments, which are in apposition with one another, fuse together, and furnish the first rudiments of the uterus and vagina. The free portions of the filaments become the Fallopian tubes. Both uterus and vagina are at first divided into two parts by a common partition-wall, which disappears subsequently from below upward.

Bayer (Freund's Gynäkolische Klinik, Bd. i, p. 412 *et seq.*) regards the uterus as derived not alone from the ducts of Müller, but that the retractors, the round ligaments, and the ovarian ligaments likewise contribute to the formation of its muscular structures. In the Fallopian tubes there are three layers of muscular tissue, viz., the external and internal longitudinal layers and the median layer, whose fibers run in a transverse direction. The fusion of the tubes forms, as it were, the frame upon which the uterus is built. From the external and internal longitudinal fibers are derived the longitudinal fibers of the outer and inner layers of the uterus. The spirals, which are observable at the uterine cornua, are formed from the longitudinal fibers by a semirotation of the tubes from before backward at their point of union with the uterus. The transverse fibers in the median layer of the tubes persist as circular fibers in the uterus. The retractor muscles pass to the lower portion of the cervix, are thence reflected upward, and their fibers cross at the level of the internal os.

At each point in their course they give off fibers to the substance of the uterus and contribute the principal share to the median layer of the lower uterine pole and of the cervix, forming an interlacement with the other muscular bundles. The chief mass of the posterior wall of the body, and of the layers surrounding the cornua, are derived from the ovarian ligaments, while the outer layer of the anterior wall of the corpus, of the lower portion of the cervix, and the entire supravaginal portion are derivative from the round ligaments. The median layer of the fundus is composed of fibers derived from both the round and ovarian ligaments.

The uterus, at the fourth month of fetal life, presents distinct traces of the early origin from the ducts of Müller. The fundus is undevel-

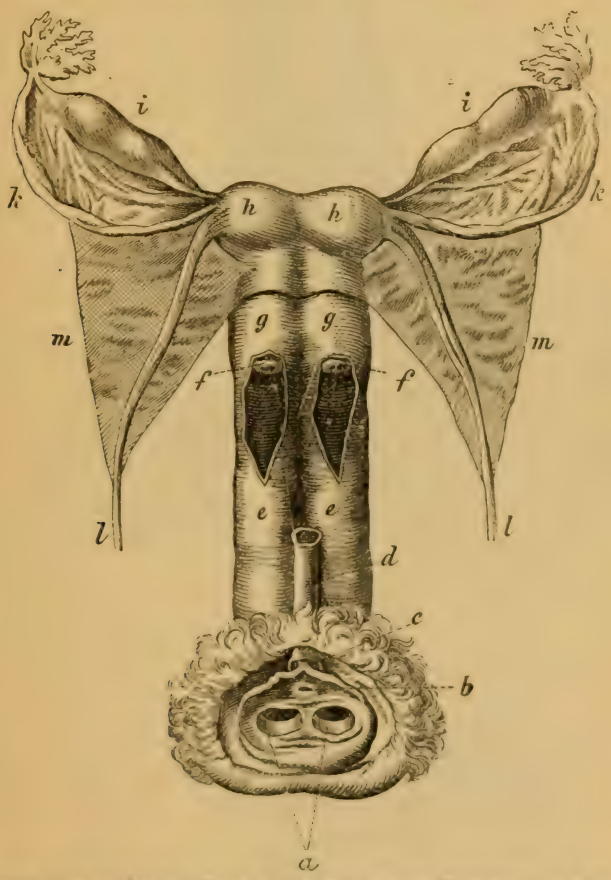


Fig. 23.—Double uterus and vagina from a girl aged nineteen (Eisenmann). *a*, double vaginal orifice with double hymen; *b*, meatus urethræ; *c*, clitoris; *d*, urethra; *e*, *e*, the double vagina; *f*, *f*, uterine orifices; *g*, *g*, cervical portions; *h*, *h*, bodies and cornua; *i*, *i*, ovaries; *k*, *k*, Fallopian tubes; *l*, *l*, round ligaments; *m*, *m*, broad ligaments. (Courty.)

oped. The ridges of the arbor vitæ uterina, which are confined at a later period to the cervix, extend the entire length of the uterus. A

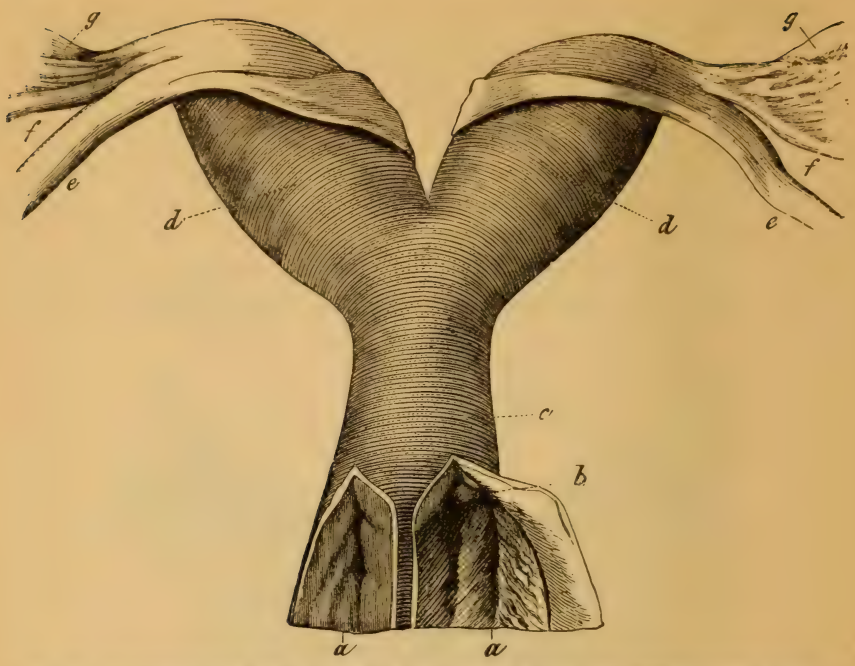


FIG. 24.—Uterus bicornis, double cavity and double vagina, from a girl seventeen years of age. *c*, cervical portions united together, presenting the appearance of a single cervix ; *d*, *d*, the two cornua. (Schroeder.)

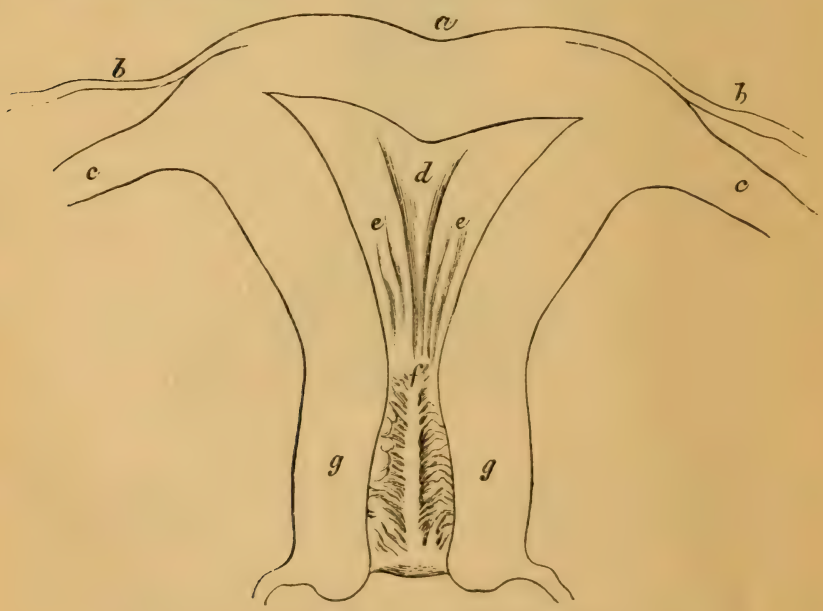


FIG. 25.—Uterus cordiformis, double natural size. (Kussmaul.)

depression at the fundus marks the point of union between the ducts of Müller. Two cornua, or horns, are thus distinguishable upon the external surface of the uterus. About the eighth or ninth month the convex fundus is developed, and the cornua disappear externally, though all through life they are traceable upon the inner surface in lateral sections of the uterus (*vide* Fig. 15, p. 21).

Before the differentiation of sex has taken place, the external organs of generation present the following appearances: Two ridges, or folds, surround a central opening (sinus uro-genitalis), which either unite to form the scrotum of the male, or develop into the labia majora in the female. Where these folds join together above, there is a small projecting body, or tubercle, destined to become the penis or the clitoris. In either case the lower surface of the tubercle is furnished with a groove. The margins of the groove extend along the sides of the sinus uro-genitalis, and, in the development of the female type, become the

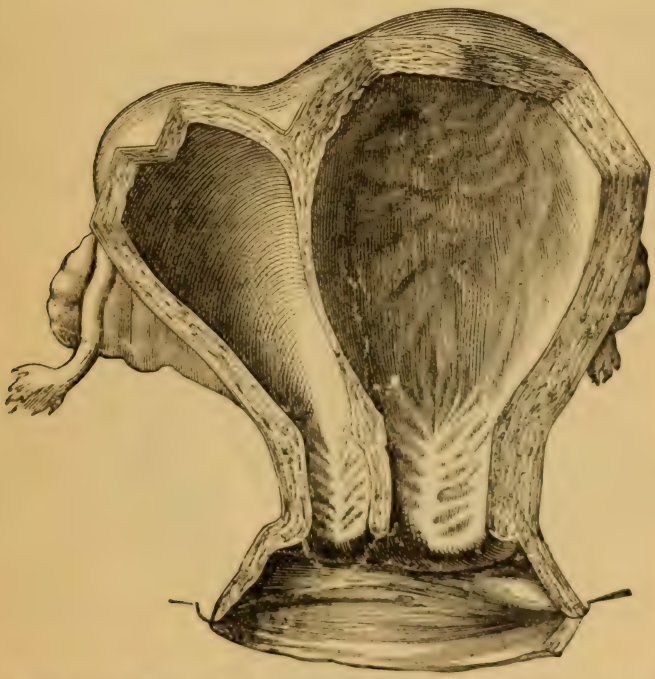


Fig. 26.—Uterus septus bilocularis. Double uterus, with simple vagina, seen from the front. Left walls more developed in consequence of pregnancy. (Cruveilhier.)

labia minora. The sinus uro-genitalis affords a common aperture for the bladder and internal organs of generation.

Abnormalities of the Uterus.—An arrest of fetal development gives rise to a number of deviations from the ordinary uterine type, of

which we borrow from Courty the following as of direct obstetrical importance:

1. **Uterus Unicornis.**—The one-horned uterus results from the atrophy or incomplete development of one of the filaments of Müller, while the other continues its evolution. We then have a uterus which is composed of a single lateral half, possessing generally but one Fallopian tube.

2. **Uterus Duplex, or Didelphys.**—Both filaments of Müller are developed, but do not become united together. Thus two distinct uteri are produced, of which each represents in reality the half of a normal uterus.

3. **Uterus Bicornis.**—Partial union of the filaments of Müller takes place, but without reaching the ordinary level indicated by the insertions of the round ligaments. The upper portion of the uterus is thus divided into two horns, separated by a furrow from one another.

4. **Uterus Cordiformis.**—The uterus remains of the fetal type indicated in Fig. 25. Instead of a complete development of the fundus, the latter remains depressed, and presents an appearance remotely resembling the heart of a playing-card.

5. **Uterus Septus Bilocularis.**—Complete union of the two filaments of Müller has taken place, but the common wall, formed by their coalescence, persists. We have thus two distinct uterine cavities. The septum may extend the whole length of the vagina, and give rise to a double vagina; or absorption of the vaginal septum and a portion of the uterine septum may have taken place, so that we may have a double uterine cavity with a single cervix, *uterus semi-partitus.*

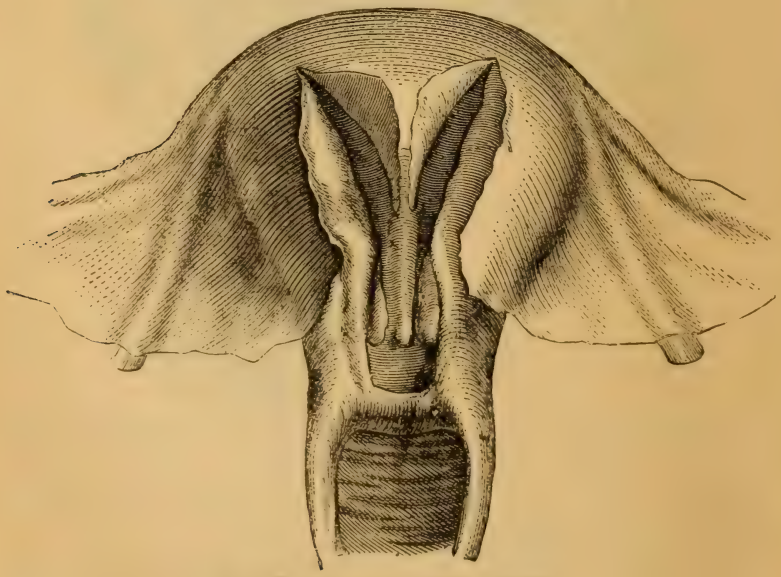


FIG. 27.—Uterus semi-partitus. (Gravel.)

PHYSIOLOGY OF THE OVUM.

CHAPTER II.

DEVELOPMENT OF THE OVUM.

The Graafian follicles and the ovum.—Discharge of the ova from the ovary, and the formation of the corpus luteum.—The migration of the ovum.—Fecundation.—Changes taking place in the ovum subsequent to fecundation.—Nourishment of the embryo.—The allantois and chorion.—The deciduæ.—The placenta; its development and structure.—Formation of the umbilical cord.—The amniotic fluid.

The physiology of the ovum comprises its genesis, development, and discharge from the ovary, its fecundation, and the entire series of subsequent changes by which the simple structure of the germ becomes converted into a complex organism presenting the specific characteristic of the parent.

The following account of the history of the ovum is derived in great measure from Waldeyer.*

The Graafian Follicles and the Ovum.—In the embryo of the chick, by the fourth day of incubation, the Wolffian body is covered by cylindrical epithelium, contrasting sharply with the flattened cells of the peritonæum. Soon after, a thickening of the epithelium becomes noticeable on the inner side, and forms the earliest trace

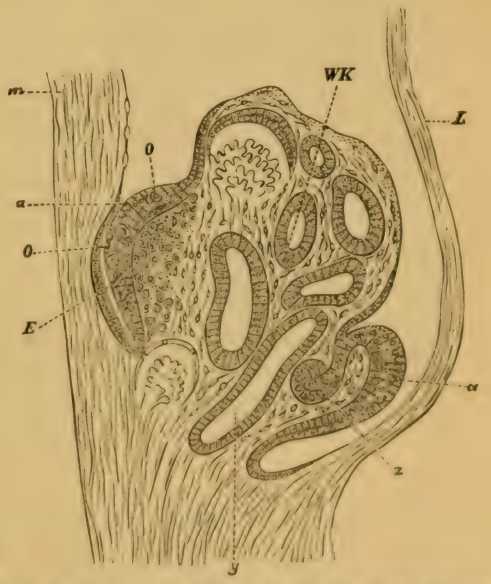


Fig. 28.—Section of Wolffian body, with rudimentary ovary (embryo of chick, fourth day of incubation). *WK*, Wolffian body; *y*, section of Wolffian duct; *a*, *a*, thickened epithelium; *z*, duct of Müller; *E*, early stage in development of ovary; *O*, *O*, primordial ova; *m*, mesentery; *L*, lateral wall of abdomen. (Waldeyer.)

* Eierstock und Nebeneierstock, Stricker's Handbuch der Lehre von den Geweben, Leipsic, 1871; Eierstock und Ei, Leipsic, 1870.

of the ovary. Next, a small rounded elevation, rich in cells, and derived from the interstitial tissue of the Wolffian body, makes its appearance underneath the thickened epithelium. The epithelium is destined to form the Graafian follicles and ova; the proliferated connective tissue furnishes the vascular stroma of the ovary. Between the fourth and fifth day certain cells already indicate their destiny as future ova, by their size, their rounded shape, and large nuclei. The further development of the ovary is the result of the multiplication of the epithelial cells and the continued growth of the stroma. As the connective-tissue processes grow outward and penetrate between the cells, the latter gradually become imbedded in the stroma. Thus, the connective-tissue processes assume a trabecular arrangement, the meshes of which are filled with cell-masses of a nearly cylindrical shape, which hang together in the form of a net-work. Among the imbedded cells, the large ones already noticed are termed "primordial ova." The smaller cells remain small, and arrange themselves like epithelium around the larger ones. In the course of development, the interpenetration of the connective tissue continues, until each primordial ovum is contained in its own separate partition. These partitions, with the included cells, are rudimentary Graafian follicles. Two distinct ova within the same Graafian follicle are of rare occurrence. As the ova enlarge and the epithelial cells multiply, an irritative action is set up in the surrounding stroma. An increase in vascularity results, and young connective tissue is developed about each epithelial collection. As the follicle grows, the outer layer becomes fibrillated. Thus around each Graafian follicle a distinct envelope is formed, termed by Baër the *theca folliculi*, consisting of an internal vascular coat, the *tunica propria*, and an external fibrillated coat, the *tunica fibrosa*.

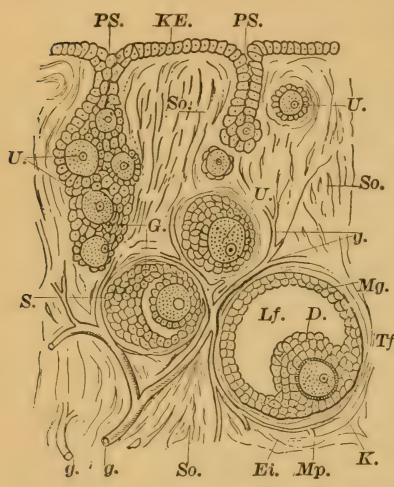


FIG. 29.—Section through portion of the ovary of mammal, illustrating mode of development of the Graafian follicles (Wiedersheim). *D*, discus proligerus; *Ei*, ripe ovum; *G*, follicular cells of germinal epithelium; *g*, blood-vessels; *K*, germinal vesicle (nucleus) and germinal spot (nucleolus); *KE*, germinal epithelium; *Lf*, liquor folliculi; *Mg*, membrana or tunica granulosa, or follicular epithelium; *Mp*, zona pellucida; *PS*, ingrowths from the germinal epithelium, ovarian tubes, by means of which some of the nests retain their connection with the epithelium; *S*, cavity which appears within the Graafian follicle; *So*, stroma of ovary; *Tf*, theca folliculi or capsule; *U*, primitive ova. When an ovum with its surrounding cells has become separated from the nest, it is known as a Graafian follicle.

Each primordial ovum is at first encircled by a single layer of cylin-

drical cells. Gradually new layers form, in which the ovum lies imbedded. Afterward, at a point remote from the ovum, a crescent-shaped opening makes its appearance, which becomes filled with a clear fluid derived from transuded serum, and in part from liquefied epithelium. A heap of cells remains about the ovum and forms the *discus proligerus*. With the increase of the follicular fluid the cylindrical

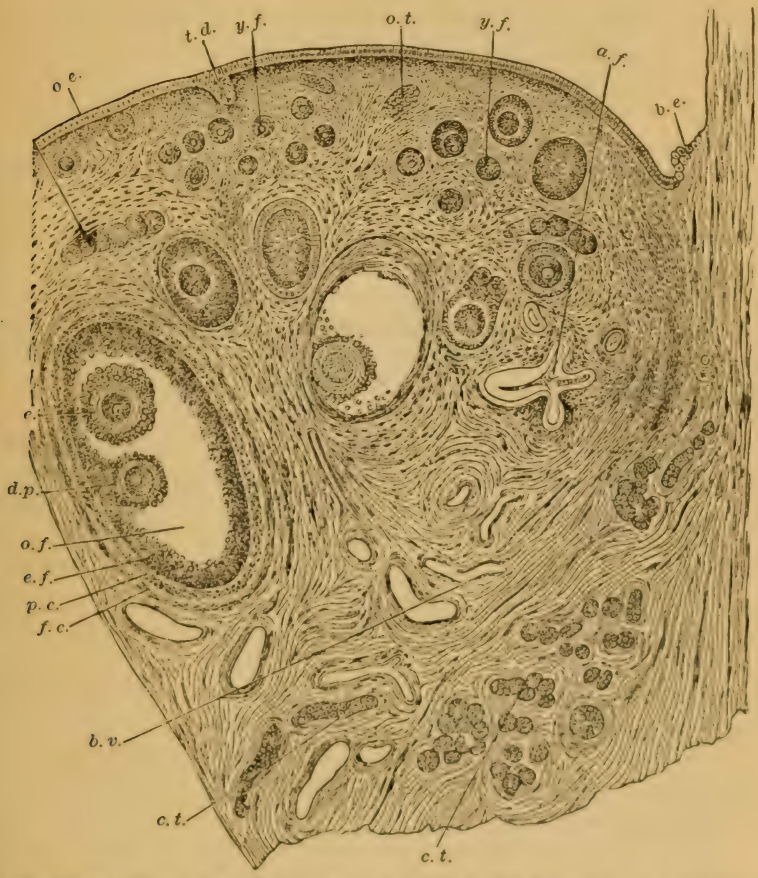


FIG. 30.—Sagittal section of the ovary of an adult bitch (after Waldeyer). *o. e*, ovarian epithelium; *o. t*, ovarian tubes; *y. f*, younger follicles; *o. f*, older follicle; *d. p*, discus proligerus, with the ovum; *e*, epithelium of a second ovum in the same follicle; *f. c*, fibrous coat of the follicle; *p. c*, proper coat of the follicle; *e. f*, epithelium of the follicle (membrana granulosa); *a. f*, collapsed atrophied follicle; *b. v*, blood-vessels; *c. t*, cell-tubes of the parovarium, divided longitudinally and transversely; *t. d*, tubular depression of the ovarian epithelium, in the tissue of the ovary; *b. e*, beginning of the ovarian epithelium, close to the lower border of the ovary.

cells are pressed against the membrana propria, and form a third coating, or layer, termed the *membrana granulosa*.

A glance at a transverse section through the ovary of a mature mammal exhibits follicles of different ages. To recapitulate:

The *young follicles* are composed of primordial ova, surrounded by epithelium, and imbedded in the ovarian stroma.

The *fully developed follicles* possess a vesicular character. They are surrounded by a connective-tissue wall (theca folliculi), which is composed of two layers (tunica propria and tunica fibrosa). The tunica propria is lined by cells (membrana granulosa), which are gathered in heaps (discus proligerus) around the ova. The discus proligerus is seated sometimes superficially, sometimes in the deepest portion of the follicle. Each ovum is surrounded by a special layer of cylindrical epithelium (epithelium of the ovum).

Henle estimates the entire number of Graafian follicles in each ovary at thirty-six thousand.

The primordial ova, we have seen, consisted originally of epithelial cells distinguished by their rounded shape and large nuclei. For a certain period these cells have a continuous growth, due probably to the absorption of nutritive material furnished by the liquefaction of cells in the discus proligerus. The nutrient material, according to Nagel,* is derived from special cells containing nuclei and one or more nucleoli, and of larger size than the ordinary follicular epithelium. The liquefied product, Nagel maintains, enters the protoplasm of the primitive ova by diffusion.

The fully developed ovum is no longer a simple cell composed of protoplasm. It is of large size. In the human female the ovum measures about $\frac{1}{120}$ of an inch in diameter. As it lies in the discus proligerus it is surrounded by elongated cells with distinct nuclei and finely granular protoplasm. These cells are placed side by side, and are arranged in two to three layers. By Waldeyer they have been termed the epithelium of the ovary, and by Bischoff, owing to their characteristic appearance, the zona radiata.

The mature ovum possesses a thick, transparent envelope, termed the *vitelline membrane* or, from the manner in which it transmits light, the *zona pellucida*. The zona pellucida was formerly thought to be due to a thickening of the cell contour. It is now commonly regarded as something superadded to the primordial ovum. Probably the attached portions of the radiate cells contribute to its formation. It has been noticed as a curious coincidence, that at the time of the appearance of the zona pellucida a similar clear, structureless membrane develops between the membrana granulosa and the internal layer of the theca folliculi. When the zona has once formed around the ovum the latter ceases to increase in size.

The ovum and the zona are not in immediate contact. Between the two there exists a clear space, termed the perivitelline space, which

* W. Nagel, Das Menschliche Ei, Arch. für Microscopische Anatomie, vol. xxxi, pp. 380 and 381. The ovaries were examined in a perfectly fresh condition after their removal from the body for surgical reasons.

permits amœboid movement and rotation of the egg protoplasm to take place. The thickness of the zona is from one twentieth to one tenth the diameter of the ovum.

The body of the cell, which constitutes the primordial ovum, becomes the vitellus of the ripe egg. It possesses contractility and other properties of protoplasm. In the mature ovum it assumes an opaque appearance, due to the development of granular matter and light-refracting particles. The primitive cell matter of the vitellus is termed the protoplasm of the ovum, or the formative yelk. From it are derived the cells which furnish the basis of embryonic development. The small particles consist of nutrient material, and are termed deutoplasm, or the nutritive yelk, as they constitute at an early period the material which contributes to the cell growth. The deutoplasm is supposed to be derived from the liquefied cells of the discus proligerus, but in the human ovum the penetration of particles from without is not direct. They do not appear until after the zona is formed, when the growth of the ovum ceases. They therefore are to be regarded as the product of the vital activity of the cell. Upon the addition of eosin the protoplasm is colored with a beautiful rose tint, while not a trace of the coloring matter is taken up by the deutoplasm (Nagel). The particles first make their appearance at the center of the vitellus. In the perfectly fresh human ovum it is possible to distinguish a central portion rendered opaque by deutoplasm, a finely granular ring in which the protoplasm predominates, and a clear peripheral border in which the protoplasm is free from deutoplasmic matter.

The nucleus of the cell becomes converted into a large, clear, colorless vesicle, known as the germinative vesicle. It occupies an eccentric position in the clear outer zone of the vitellus. The nucleolus persists as a dark, probably solid body within the germinative vesicle. It is characterized by amœboid changes of shape, and is termed the germinative spot.

Discharge of the Ova from the Ovary, and the Formation of the Corpus Luteum.—We have already seen that the number of Graafian follicles within a single ovary is estimated at many thousands. The formation of these follicles is, in great degree at least, completed during the antenatal period of existence. Previous to puberty, however, they remain in a quiescent condition. With the advent of puberty the ovaries assume functional importance. The surface of the ovary, if examined at this time, is no longer smooth, but studded with small vesicles. These vesicles are nothing more than the enlarged Graafian follicles, which, as they become distended by their fluid contents, approach the periphery, thin the tunica albuginea, and form rounded translucent prominences. By the additional disappearance of the blood-vessels and the lymphatics, a weak point in the wall of the follicle, the *macula* or *stigma folliculi*, is left exposed.

The discharge of the ovum is closely associated with the formation of the corpus luteum.

The *corpus luteum* begins by an abundant cell proliferation, in which both the follicular epithelium and the tunica propria participate. This cell proliferation is most abundant at the bottom of the Graafian follicle. Vascular arches push forth into the cavity, and still further encroach upon the already crowded space. Finally, a point is reached at which the follicle ruptures, and its contents, including the ovum, are discharged. When the Graafian follicle has reached maturity, the congestion, occurring at the time of the menses, operates unquestionably in a most effective manner to the accomplishment of this result.

Immediately following the rupture of the Graafian follicle, blood is effused into its cavity. At the same time a process of cell disintegration ensues. But, in place of a degenerative product, the disintegration furnishes a granular, vitellus-like substance of a yellow color. Examined by the microscope, in addition to the granular mass, globules may be recognized, which correspond to the light-refracting particles contained in the vitellus of the ovum.

While the above-mentioned process is going on, an abundant transmigration of wandering cells (lutein cells, Nagel) from the vascular network surrounding the follicle takes place, which lift up the granulosa cells, with the pseudo-yelk substance, and press them toward the center of the follicle. Along with the young wandering cells, vascular offshoots, like small papillæ, push out from every side into the epithelial and vitellus-like masses. As the larger vessels form more marked projections, they give to the corpus luteum a folded appearance.

In a state of complete development the corpus luteum consists of— 1. The pseudo-yelk substance, mingled with effused blood. 2. The thickened layer of the granulosa and lutein cells, mingled with yelk-substance. It is this layer which, to a great extent, forms the folded, yellow portion of the corpus luteum. 3. The vessels which, with the lutein cells, push from all directions into the epithelial masses. As these vessels reach the center of the follicle, a complete interpenetration of the connective tissue and epithelial elements of the corpus luteum results, and the foldings become indistinct.

Finally, absorption of the vitellus-like substance occurs; the last vestiges of the effused blood are converted into blood-crystals; the arterial vessels degenerate; the epithelial masses and the connective-tissue mesh-works disappear gradually, until at the last only a white, stellate cicatrix remains.

If the ovum is discharged without impregnation taking place, the corpus luteum reaches its maximum size at the end of three weeks, and then begins to decline, until, at the end of two months, it is reduced to an insignificant cicatrix. But when conception occurs, the changes in the corpus luteum take place more slowly. The corpus luteum reaches

a higher state of development. Its increase in size continues for two months. It then remains stationary up to the end of the sixth month. During the last three months of pregnancy it gradually loses its bright-yellow color, grows smaller, but still measures one half of an inch in diameter at the end of the period of gestation.

The corpus luteum of pregnancy is often termed the *true* corpus luteum, to distinguish it from the more trivial variety which is produced by the rupture of a Graafian follicle at a menstrual period, or between two menstrual epochs. The latter has been termed the *false* corpus luteum, because it is found in virgins, and does not constitute a sign of pre-existent pregnancy.

The Migration of the Ovum.—The number of ova in each ovary amounts to many thousands. Only a small proportion of them, however, meet with the conditions requisite for fruition. It is probable that many ova perish while still surrounded by the stroma of the ovary. It becomes an interesting subject of inquiry as to the conditions which ordinarily determine the passage of the ovum from the ovary into the Fallopian tube of the corresponding side. It will not do to assume, as is usual, a peculiar erectility of the Fallopian tube, which enables it to apply its funnel-shaped extremity to the ovary just at the moment of the rupture of the Graafian follicle. Setting aside the inherent improbability of the existence of such a degree of intelligence in the fimbriæ as would lead to the exact adaptation of the tube to the precise point at which the ovum is to be discharged, it has been proved that the Fallopian tube possesses none of the characteristics of erectile tissue. Injections of its vessels after death do not communicate to it the slightest change of form or place.*

Muscular action has also been often invoked to explain the assumed manner in which the fimbriæ seize the ovary, but galvanization of the tubes, practiced upon criminals recently executed, produces only vermicular contractions, which do not affect the position of the fimbriæ.† Indeed, when we remember the position of the Fallopian tubes in the pelvis, and bear in mind that they are at all times necessarily subjected to the pressure of the intestines, it becomes difficult to understand how they can execute any very extended movements.‡

* Rouget, Les Organes Érectiles de la Femme, Jour. de la Physiol., t. i, 1858, p. 337.

† Hyrtl, Handbuch der topographischen Anatomie, Wien, 1865, Bd. ii, p. 210.

‡ Henle, Handbuch der Eingeweidelehre, Braunschweig, 1866, p. 470. Rouget (*vide* Organes Érectiles, Jour. de la Physiol., 1858) has studied with great care the arrangement of the muscular fibers situated between the peritoneal layers of the broad ligament. These fibers are directly continuous with the delicate external muscular layer of the uterus. Certain of them are so distributed, according to Rouget, as to produce by their contraction a direct approximation of the fimbriæ to the ovary. Henle remarks, by way of criticism, that more stress might be laid upon these fibers were they distributed to the Fallopian tubes alone. As, however, they

In the absence of direct experimental proof, the suggestion of Henle that the passage of the ovum into the Fallopian tube is due to the currents produced in the serum by the ciliated epithelium, which covers both the external and internal surfaces of the fimbriæ, is, on the score of probability, entitled to the most consideration. One of the fimbriæ (fimbria ovarica, Fig. 13) is, as we have already seen, permanently attached to the lower angle of the ovary. It is likely that the ovum, discharged from a Graafian follicle, is floated down by the peritoneal serum toward the lower and outer border of the ovary, where a sufficient current is present to insure its being caught up and conveyed into the infundibulum tubæ. Failures on the part of the ovum to reach its destination are, in all probability, not uncommon. Support is given to the theory of the importance of the ciliæ in influencing the migration of the ovum by the observation of Thiry,* that in batrachians, which have the oviducts fixed to the abdominal walls, and situated at a distance from the ovary, during the rutting period little pathways of ciliated epithelium form in the peritonæum, which collectively converge toward the openings of the tubes.

Cases of the complete migration of the ovum from the ovary of one side to the Fallopian tube of the opposite side are not readily explained by any hypothesis. Yet the occurrence of such cases is undoubted. Pregnancy, for instance, may exist where there is complete absence or closure of the Fallopian tube upon the same side with the corpus luteum. Leopold tied the right Fallopian tube in rabbits in two places, and exsected a portion of the tube between the ligatures; the left ovary was carefully removed and the abdominal wound was closed. After recovery the rabbit was put to the male. In two such cases pregnancy followed.†

The progression of the ovum through the Fallopian tube is effected by the current produced by the ciliated epithelium and by the peristaltic action of the circular muscular fibers.

Fecundation.—The precise point at which fecundation takes place has been variously assigned by authors to the tubes, the uterus, and the ovary. The question, however, up to the present time is a purely speculative one. The length of time required by the human ovum to complete the passage from the ovary to the uterine cavity is unknown; nor has as yet the period of the extra-ovarian life of the ovum, when not vivified by the contact of the male element of generation, been determined. Single observations show that fecundation may take place in any part of the course described. The ordinary site of fecundation is a matter which remains to be decided by future investigations.

spread likewise over the ovary, their probable action would consist in drawing both ovary and tube toward the median line.

* Thiry, Göttingen Nachrichten, 1862, p. 171.

† Arch. f. Gynaek., vol. xvi, p. 24.

The *semen*, contact with which is essential to the fecundation of the ovum, is a thick, viscid, albuminous fluid, of a whitish color and a peculiar odor, which has been compared to that of the raspings of bone. When examined by the microscope, it is found to contain numerous minute anatomical elements, termed *spermatozoa.* Each spermatozoön consists of an oval head and a long filiform extremity or tail. The head is flattened, and measures about $\frac{1}{8000}$ of an inch in width. When seen in profile, it presents a pyriform appearance. The entire spermatozoön measures from $\frac{1}{800}$ to $\frac{1}{400}$ of an inch in length.

Fig. 31.—Spermatozoa from the human subject (magnified eight hundred diameters). (Luschka.)

The spermatozoa do not simply float in the seminal fluid, but possess the capacity of moving from place to place, as though endowed with volition. Indeed, as the observer sees them advance, now singly and now in shoals, now diving down and then rising again to the surface, now avoiding some obstacle, or skillfully picking their way between masses of epithelium, it is difficult to resist the conviction that they are really, what they were long supposed to be, distinct organisms capable of a certain degree of voluntary action. But there is little doubt, at the present day, that the undulatory movements of the tail, which furnish the propelling force, are due to purely molecular tissue changes, similar to those which give rise to the amœboid movements of protoplasm or the oscillations of the hair-like processes of ciliated epithelium.

Henle estimates that the spermatozoa travel at the rate of an inch in seven and a half minutes. It is to these bodies that the semen owes its fecundating power, but only so long as they retain the faculty of motion—a faculty which has been found to exist in full force, within the female genital organs, eight to ten days after ejaculation.*

In 1840 Martin Barry described a point in the zona pellucida (vitelline membrane) of the rabbit, which appeared to him to be an opening designed for the passage of spermatozoa. At first embryologists pronounced Barry's descriptions to be based upon an illusion, but since then the existence of such an opening, termed later by Keber the *micropyle*, has been abundantly demonstrated in the ova of fishes, mollusks, insects, etc.†

A very interesting series of observations connected with this subject have been made by M. Robin upon the ova of the *nephelis vulgaris*, or common leech. The earliest token of the maturity of the

* Luschka, Die Anatomie des menschlichen Beckens, Tübingen, 1864, p. 273.

† *Vide* Milne-Edwards, Leçons de la Physiologie, t. viii, Paris, 1873, pp. 361 *et seq.*; Waldeyer, Eierstock und Nebeneierstock, Stricker's Handbuch, p. 354.

ovum consisted in the disappearance of the germinative vesicle. At the same time a retraction took place in the vitellus, which became thereby reduced one sixth to one fourth in size. At first the removal of internal pressure, consequent upon this retraction, led to a wrinkling of the vitelline membrane. Afterward, however, a clear, limpid fluid, probably in part exuded from the vitellus and in part derived by endosmosis from external sources, filled up the intervening space, and caused the wrinkles to disappear. The spermatozoa, in their movements around the ovum, assumed a perpendicular or oblique direction to the vitelline membrane. At one point in the membrane the penetration of these bodies could be distinctly observed. At the end of an hour the penetration had ceased, and then a little bundle of spermatozoa could be seen arrested, partly within and partly without the ovum. In the clear, limpid space surrounding the vitellus, the spermatozoa continued to move about actively for a time, but in fifteen to twenty minutes their movements began to grow slow, and in a couple of hours had ended altogether.*

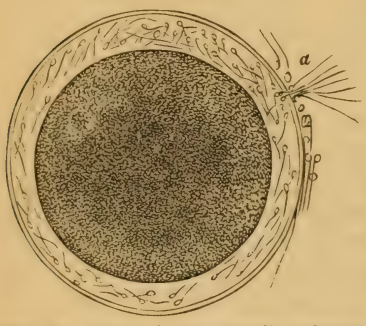


FIG. 32.—Ovum of the nephelis vulgaris, showing retraction of vitellus and the penetration of the spermatozoa through the vitelline membrane (magnified three hundred diameters). (Robin.)

In the human ovum nothing in the nature of a micropyle has been observed. The fine radiate lines which may be seen in the zona pellucida when high magnifying powers are employed do indeed suggest the idea of minute pores, but the view of Waldeyer † has been generally accepted, that these are really unchanged filaments of protoplasm derived from the cells to which the zona pellucida owes its origin.

CHANGES TAKING PLACE IN THE OVUM SUBSEQUENT TO FECUNDATION.

In describing its anatomy, we have noted that the ovum was originally a simple cell, possessing contractility and other properties of living matter. The ova of certain of the sponges, which do not possess a zona pellucida, move about under the field of the microscope by pushing out finger-like processes, precisely like the ordinary amœba.‡ Contractile movements of the vitellus within the zona pellucida have

* Mémoire sur les Phénomènes qui se passent dans l'Ovule avant la Segmentation du Vitellus, ROBIN, Jour. de la Physiol., t. v, pp. 67 *et seq.*

† WALDEYER, Eierstock und Nebeneierstock, STRICKER'S Handbuch der Lehre von den Geweben, Leipsic, 1871, p. 354.

‡ HAECKEL, Anthropogenie, Leipsic, 1874, p. 112.

been described by Robin in the ova of the leech and other low orders of animal life.*

With the formation of the deutoplasm the germinative vesicle is crowded to the periphery of the ovum.

The maturity of the ovum is signalized by the detachment from the main mass of two small cells termed the polar globules. Formerly this process was supposed to be associated with the disappearance of the germinal vesicle. More recent investigations have demonstrated that in the production of the polar globules the germinative vesicle plays an active part. Thus observation shows that the latter elongates in a radiate direction. Around the two extremities, or poles, nuclear matter from the vitellus collects. A separation of the lines connecting the poles next takes place, and two new nuclei surrounded by radiate masses of yelk matter result. These have a star-like arrangement. The upper pole is then extruded and the first polar globule is formed. The process is then repeated, and the second polar globule is perfected. Finally the persistent portion of the original nucleus recedes from the surface. It resembles in appearance the original germinal vesicle with its nucleolus, and is known as the *female pronucleus.*

The formation of the polar globules is a sign that the ovum has reached maturity, and occurs independently of fecundation. The latter is effected by the penetration into the vitellus of a single spermatozoön, the head of which is termed the *male pronucleus.* The male pronucleus approaches the female pronucleus, and the two coalesce to form the segmentation nucleus of the fecundated ovum. After this union has taken place the ovum is turmed the *oösperm.*

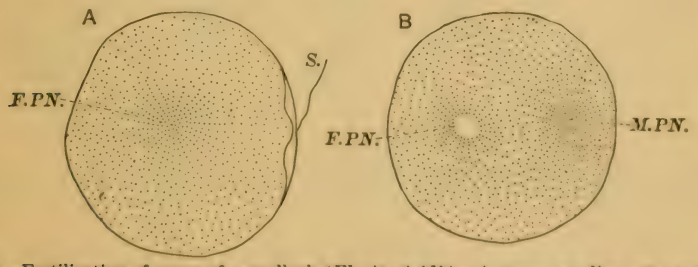


FIG. 33.—Fertilization of ovum of a mollusk (*Elysia viridis*). A, ovum sending up a protuberance to meet the spermatozoön. B, approach of male pronucleus to meet the female pronucleus. *F. PN*, female pronucleus; *M. PN*, male pronucleus; *S*, spermatozoön.

Almost immediately after the production of the segmentation nucleus it divides into two nuclei. By a similar process of cleavage the vitellus likewise divides into two halves. The nuclei act as central points, around which collect the molecular and viscid portions of the protoplasm. In this manner the ovum is divided into two new cells, which differ somewhat in size, and which lie near together within the zona

* HAECKEL, Anthropogenie, Leipsic, 1874, pp. 100 *et seq.*

pellucida. The larger cell and those subsequently derived from it are termed the epiblastic spheres, and the smaller one with its products are termed hypoblastic spheres. To the cleavage process by which the single cell has been converted into two, the term *segmentation* is applied. By continued segmentation the two cells are divided into four, the four into eight, and so in succession, until finally a great

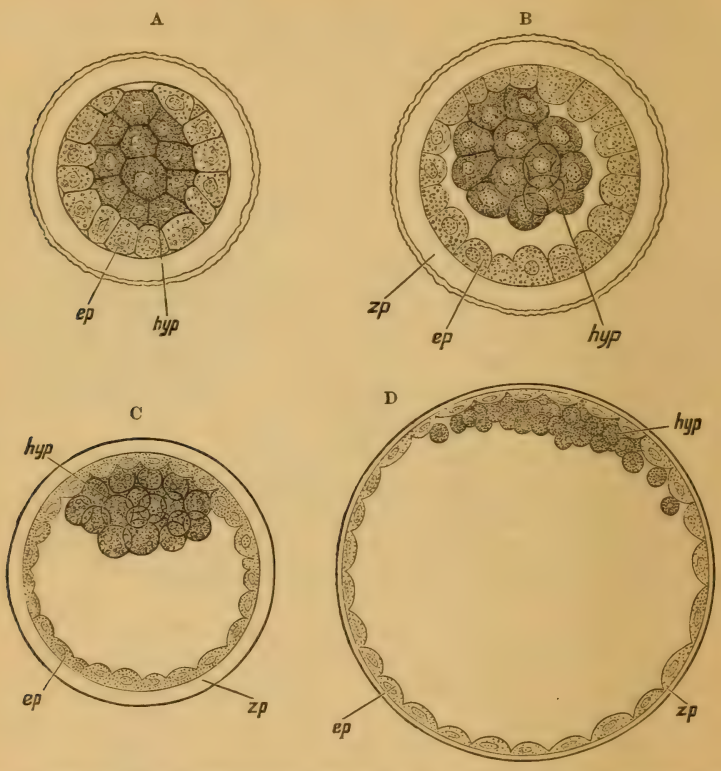


Fig. 34.—Formation of the blastodermic vesicle (Van Beneden). A, B, C, D, sections of ova in successive stages of development in the rabbit; *zp*, zona pellucida; *ep*, epiblastic cells; *hyp*, hypoblastic cells.

multitude are generated, all closely crowded together, and giving to the ovum a mulberry appearance; whence the term *morula* has been applied to the ovum at this stage of its development.

When the segmentation process is completed, the epiblast cells occupy the outer circumference and line the inner surface of the zona pellucida, except at one point, termed by Van Beneden the blastophore. They are clear, and have an irregular cubical form. The hypoblast cells form a solid mass in the center. They are granular, polygonal, and are somewhat larger than the epiblast cells.

The epiblast cells next grow over the blastophore. A layer of fluid

then forms within the morula, by means of which the epiblast and hypoblast cells are separated from one another except at the point where the blastophore had previously existed. By an increase of the fluid the morula is converted into a globular vesicle, termed the blastodermic vesicle. The hypoblast cells are pressed to the circumference, where they form a lens-shaped mass attached to the epiblast cells and projecting into the cavity of the vesicle. The blastodermic vesicle continues to enlarge rapidly. The hypoblast cells become flattened and spread over the inner surface of the epiblast. The central part thickens and forms a dark spot, which constitutes the commencement of the *embryonic area;* upon section, the embryonic area is found to consist of three layers, the outer layer composed of epiblast cells, and two inner layers composed of hypoblast cells. The former takes no active part in the formation of the embryo, but disappears at an early period. Beyond the embryonic area the epiblast cells help to form the amnion. The hypoblast cells alone contribute to the formation of the new being. The outer layer becomes the epiblast, and the inner layer forms the hypoblast of the embryo. Subsequently a third intermediate cell layer, termed the mesoblast, develops between the embryonic epiblast and hypoblast. At a later period the cells of the mesoblast and of the hypoblast spread by peripheral extension, and finally line the inner surface of the primitive epiblast.*

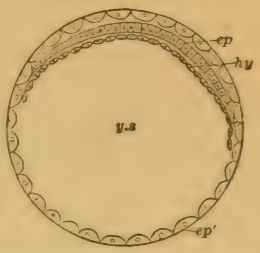


FIG. 35. — Diagrammatic section (Haddon) of mammalian blastoderm after the cover-cells have closed in the blastoderm, and the embryo proper has become two-layered. *ep'*, non-embryonic epiblast; *ep*, embryonic epiblast; *hy*, hypoblast; *y. s*, yelk sac.

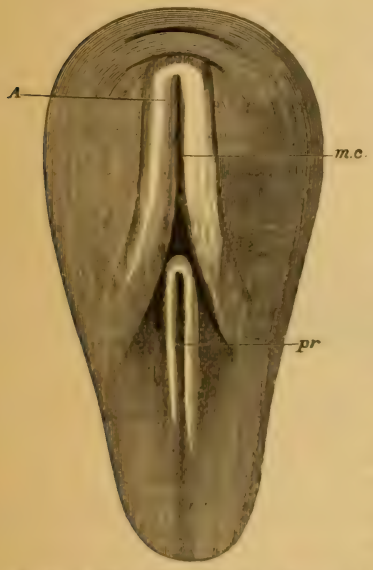


FIG. 36. —Surface view of area pellucida of hen's egg, after eighteen hours of incubation (Balfour). *A*, medullary folds; *m.c*, medullary groove; *pr*, primitive groove.

Without entering minutely into the subject, it may be well to state that, according to present views, the three layers existing at the em-

* This description is taken from Van Beneden's Developpement Embryonnaire des Mammifères, Bull. de l'Acad. Belgique, 1874. *Vide* translation in article The Physiology and Histology of Ovulation, Menstruation, and Fertilization, etc., by Newell Martin, Hirst's System of Obstetrics, vol. i, p. 101.

bryonic area are assumed to have the following relations to the ulterior development of the body:

The epiblast is concerned in the formation of the epidermis, hair, nails, the epithelium of the mouth, nose, and of the cloaca, the glandular structures of the skin, the brain, the spinal cord, and the organs of special sense.

The hypoblast furnishes the epithelium lining the walls and glands of the intestines, and the epithelium of the lungs and of the air passages.

The mesoblast gives rise to the corium, the muscles of the trunk, the bony framework, the connective tissues, the muscular structures of the digestive tracts, the blood, the blood-vessels, and the genito-urinary system.*

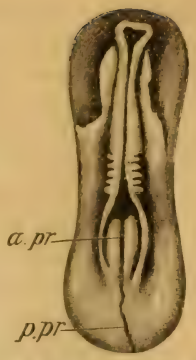


FIG. 37.—Dorsal view of embryonic area of blastoderm of chick after the medullary folds have arched over and met for a great part of their extent but have not yet fused together. *a. pr.* anterior part of primitive groove; *p. pr.* remnant of posterior part of primitive groove.

The first change observed in the embryonic area consists in the appearance of a dark streak, the primitive streak, due to a thickening of the mesoblast. It becomes grooved, and is known as the primitive groove. It has nothing to do with the development of the embryo. The embryonic area, which was previously of a rounded form, now assumes an ovoid shape. In front of

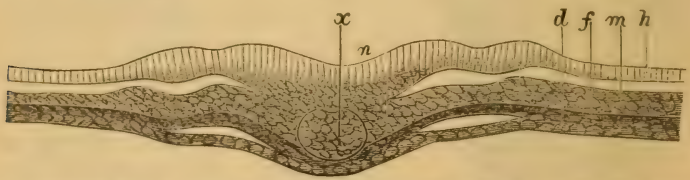


FIG. 38.—Transverse section through the embryo of the chick a few hours after the commencement of incubation. *h*, epiblast; *m*, external stratum of mesoblast; *f*, internal stratum of mesoblast; *d*, hypoblast; *n*, medullary groove; *x*, chorda dorsalis.

the primitive trace two ridges are formed by a thickening of the epiblast. These ridges are known as the medullary folds. They bound a furrow termed the medullary groove. The folds at first diverge behind, but soon converge and meet so as to include between them the front portion of the primitive trace.

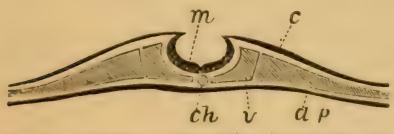


FIG. 39.—Diagram representing transverse section through the embryo of a chick at the end of the first day of incubation. *m*, medullary plates; *ch*, chorda dorsalis; *v*, vertebral chords; *a p*, abdominal plates.

Upon microscopic examination of a transverse section at

* HAECKEL, Anthropogenie, p. 218. According to His, the three primitive layers are concerned in the formation of the epithelial, the muscular, and the nerve tissues only, whereas the blood and connective tissues, comprising the leucocytes, the red blood-corpuscles, the blood-glands, the endothelia, and all the connective-

this time the three layers of the embryo are found in the vertebrata to be united at the median line. The intermediate layer (mesoblast),

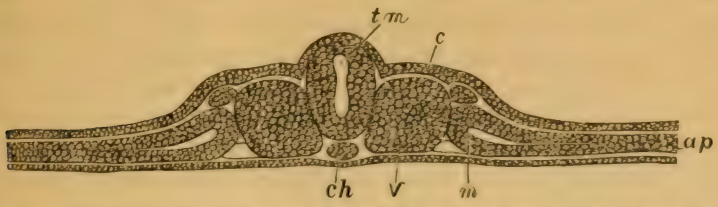


FIG. 40.—Transverse section through the embryo of a chick on the second day of incubation. (Magnified one hundred diameters). *t m*, the dorsal plates have closed to form *tubus medullaris*; the connection with the outer or cutaneous layer (*c*) is broken off; *ch*, chorda; *v*, vertebral chords; *a p*, the abdominal plates, have separated into an external and internal stratum, united at *m* to form the mesenteric folds.

which possesses the greatest thickness, already presents the appearance of two closely connected strata. The medullary groove may be recognized in the middle of the upper surface, and the dorsal plates are seen rising up as low ridges. At the same time, just beneath the furrow, a cylindrical organ, known as the *chorda dorsalis*, becomes separated from the cell-mass. The chorda dorsalis owes its importance to the fact that it is around this cylindrical body that the vertebræ subsequently form. The vertebræ themselves are derived from two longitudinal chords, separated by a cleavage from the portions of the intermediate layer next to either side of the chorda dorsalis. The peripheral portions of the intermediate layer are now termed the *lateral* or *abdominal plates*. Meantime the medullary folds continue to grow, and, by curving toward one another, finally meet in the median line, so as to

FIG. 41.—Section through the ovum of chick after development of umbilical vesicle. *c h*, chorda dorsalis; *t m*, tuba medullaris; *o m*, outer layer of mesoblast, from which are formed the bony skeleton, the blood-vessels, and large muscles of the trunk; *ect*, epiblast; *int*, intestinal tube, formed from the inner stratum of the mesoblast and the hypoblast (*ent*); *u v*, umbilical vesicle, continuous with intestine; *a p*, abdominal plates, formed from the outer stratum of the mesoblast and the hypoblast. Eventually the abdominal plates meet to inclose the cavity of the trunk (thorax and abdomen); *am*, amnion, formed from epiblast and outer stratum of the mesoblast; *z*, zona pellucida; *l*, outer lamina of the amniotic folds, derived from the primitive epiblast.

tissue forms, including cartilage, bone, and teeth, are derived from cell elements outside the area germinativa into which they subsequently migrate and especially invade the median layer. The three primary layers His terms the archiblast, and the invading cells the parablast. The median layer is, to a great extent, a secondary formation. For an excellent discussion as to the origin of the parablast, the curious reader is referred to Archiblast and Parablast, Waldeyer, Bonn, 1883.

form a closed tube, the *tubus medullaris*, in which is developed the central nervous system. Thus it will be noticed that the organ through the agency of which the individual is brought into contact with the external world is primitively derived from the epiblastic layer.

The intermediate layer (mesoblast) now separates into an internal and external stratum, the existence of which, it has been noted, was indicated at an earlier stage. These two strata remain united by their inner borders, and form later, at the point of union, the mesenteric folds. The outer extremities of the inner of these strata now curve inward, and finally unite together to form the intestine. They inclose at the same time the hypoblast. The closure, unlike that of the dorsal plates, takes place from front to rear, as well as from the two sides. The intestinal tube is thus formed from the inner stratum of the mesoblast, which furnishes the fibro-muscular tissues, and from the hypoblast, from which the glandular structures are derived. A portion of the blastodermic vesicle is, however, not included in the intestinal tube, but hangs, during the early months of gestation, from the body of the embryo, and is termed the *umbilical vesicle* (*u v*). Finally, the epiblast and the outer stratum of the mesoblast (the fibro-muscular layer of the trunk) curve forward and inward so as to inclose a long cavity which surrounds the intestine. This cavity in mammals subsequently becomes divided by the diaphragm into thorax and abdomen.

The body of the embryo, seen in profile, at the time these changes are going on, possesses a thickened anterior or cephalic portion and a tapering posterior extremity. It manifests at an early period a tendency to elevate itself above the level of the area germinativa. The back becomes arched, and the extremities approximate toward one another. Fluid collects between the two strata of the mesoblast and separates them from one another. Of these, the outer stratum forms a union with the primitive epiblast so as to produce a single membrane, folds of which rise at the same time from the extremities and sides of the embryo, and encompass it with an outer wall or parapet. In the process of growth these folds approach one another over the *dorsum* of the embryo, and finally unite together. Thus a sac, including the embryo, is formed, termed the *amnion*, the cavity of which subsequently fills with fluid.

Nourishment of the Embryo.

It now becomes a matter of importance for us to consider the sources from which the embryo receives the nutritive materials requisite for its further growth and development.

The ovum, in its passage through the Fallopian tube, is increased in size by absorption of albuminous materials from $\frac{1}{120}$ of an inch to from $\frac{1}{60}$ to $\frac{1}{25}$ of an inch.

In describing the formation of the intestinal tube, it was noted that a portion only of the blastodermic vesicle was included by the curving inward of the inner stratum of the mesoblast, while a portion, known as the umbilical vesicle, hung from the abdomen. The umbilical vesicle is lined, like the intestinal tube, by the hypoblast, and is covered by an extension of the inner stratum of the mesoblast. At first the cavity of the vesicle communicates with the intestine. Vessels from the intestinal tube are distributed over its surface, through the medium of which it contributes to the nourishment of the embryo. This arrangement, however, is only temporary. The passage very soon becomes obliterated, and the remains of the umbilical vesicle hang downward, attached by an impervious pedicle to the intestine.

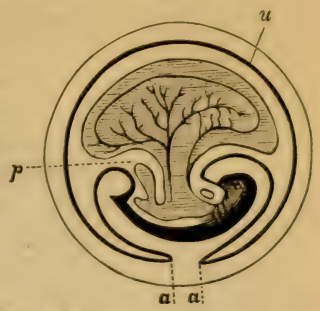


FIG. 42.—Diagram showing early stage in development of amnion. *a*, *a*, epiblast, rising up over the dorsum of embryo to form the amniotic folds; *p*, allantois; *u*, umbilical vesicle.

From the time the ovum has passed into the uterus, however, it derives its main nutritive supply from the mucous membrane of that organ, at first by simple absorption, and afterward by the formation of the placenta, an organ through which the blood of the fœtus circulates, separated from that of the mother by the thinnest of partitions. Through the party-wall there pass to the fœtus all the materials necessary for existence and growth, and from the fœtus the excrementitious principles representing the waste which is incident to vital action.

FIG. 43.—Diagram showing completion of the amnion and formation of the chorion. *A*, amnion; 1 zona pellucida; 2, outer lamina of the epiblast after closure of amniotic folds; *P*, allantois; *U*, umbilical vesicle.

There is nothing in physiology more interesting than the process by which the circulation of the fœtus is brought into close relation with that of the mother. It includes the consideration of the *allantois*, the *chorion*, the *decidua*, and finally the joint product of them all, viz., the *placenta*.

The Allantois and Chorion.—The *chorion* is the external membrane that invests the ovum. Before the formation of the amnion it consists simply of the zona pellucida or vitelline membrane. As the ovum is received into the uterus the vitelline membrane becomes covered with amorphous villi, which help to fix the ovum in the uterine cavity.

After the completion of the amnion by the closure of the amniotic folds it remains for a time attached to the outer lamina of the epiblast, at the point where the folds meet over the back of the embryo. The outer lamina meantime expands until it comes in contact with the vitelline membrane, which then disappears. Thus the outer lamina becomes in turn the external covering or chorion. The new chorion, like the one it superseded, is speedily covered by a growth of non-vascular villosities. These villosities are not solid, but hollow, like the finger of a glove. They soon reach an extraordinary development. New villi sprout upward from the chorion, the older ones push out buds and lateral offshoots, so that already in the third week the entire surface of the ovum is covered with a dense forest of villi, presenting the most delicate and graceful characters.

FIG. 44.—Human embryo at the third week, showing villi covering the entire chorion. (Haeckel.)

We have just noted that the umbilical vesicle was a temporary structure, and only for a brief period of physiological importance. Meantime a new organ is developed, by means of which a vascular connection is established between the embryo and the villi of the chorion. This organ is termed the *allantois*. The allantois begins as a sac-like projection from the posterior extremity of the intestine at the time when the amniotic folds rise up in the form of an embankment around the embryo (*vide* Fig. 43). At this time the umbilical vesicle is still very large. The allantois, like the umbilical vesicle and the intestine, is composed of two layers derived respectively from the hypoblast and the inner stratum of the mesoblast. It speedily becomes vascular, and increases rapidly in size. The inner surfaces of the sac soon adhere together, so as to form a single membrane. In the course of the third

FIG. 45.—1, exochorion; 2, endochorion; *U*, umbilical vesicle; *A*, amnion; *P*, pedicle of allantois.

Pl. III.

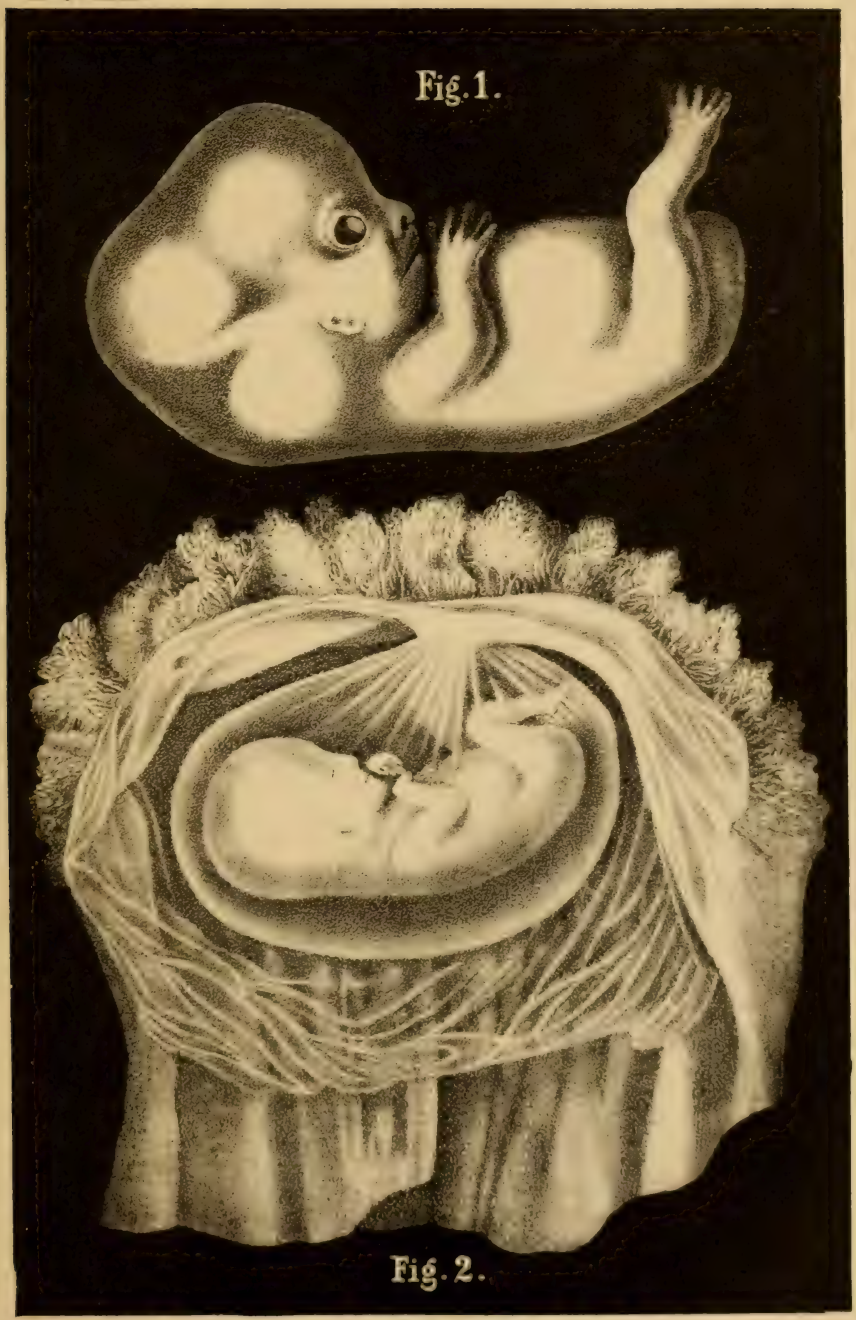


Fig. 1.—Human embryon, at the ninth week, removed from the membranes; three times the natural size (Erdl).

Fig. 2.—Human embryon, at the twelfth week, inclosed in the amnion; natural size (Erdl).

week the allantois reaches the chorion, over which it spreads and forms a complete vascular lining. According to the usual acceptation, the vessels of the allantois everywhere penetrate into the villi of the chorion. Then the chorion and allantois fuse together, and form by their consolidation a compound membrane termed *the permanent chorion.** At first the embryo is connected with the vascular chorion by two arteries and two veins. The two arteries persist as the arteries of the umbilical cord. One of the two veins disappears, while the other becomes enlarged in proportion, and forms the umbilical vein.

With the growth of the ovum its surface diminishes in vascularity, except in the neighborhood of the attachment of the allantoic vessels, at which point the villi increase in size and profusion. Over the rest of the ovum the villi atrophy and disappear. Thus the greater portion of the chorion becomes smooth, while about one third of its surface is covered with a thickened, shaggy portion, destined to contribute to the formation of the placenta.

The Deciduæ.—When the ovum passes from the Fallopian tubes into the uterus, it finds the mucous membrane prepared, by certain changes, for its reception. These changes, as shown in a specimen examined by Dr. Engelmann,† in the first month consisted of a tenfold increase in thickness (two fifths of an inch). The tissues were intensely vascular, and the entire mucous membrane was thrown into convolutions. The thickening was mainly due to an increase in the elements composing the interglandular connective tissue. This was more especially the case in the upper layers, where the cells were like those of young connective tissue. A soft, pulpy state of the mucous membrane was occasioned by an augmented production of the amorphous intercellular substance which characterizes connective tissue in the embryonic state.

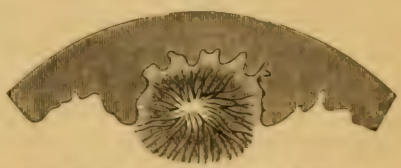


Fig. 46.—Formation of decidua, first stage.

It is this thickened, vascular, softened mucous membrane which furnishes the *decidua vera.*

The ovum, soon after its entry into the uterus, finds a lodgment in one of the folds of the decidua vera. This takes place usually in the upper portion of the uterine cavity, upon the posterior wall, near one of the tubal orifices.

The point of attachment between the ovum and the decidua is dis-

* The outer portion, derived from the epiblast, furnishes the epithelium, and is called the *exochorion*, while the inner vascular surface furnished by the allantois is entitled the *endochorion.*

† Engelmann, Mucous Membrane of the Uterus, Amer. Jour. of Obstet., May, 1875.

tinguished as the *decidua serotina.* It is physiologically important as the site of the placenta.

The ovum is not simply adherent. It lies, as it were, imbedded in the tumefied membrane, folds of which grow up around it, and finally meet so as to inclose it in a cavity of its own, shut off from the general cavity of the uterus.*

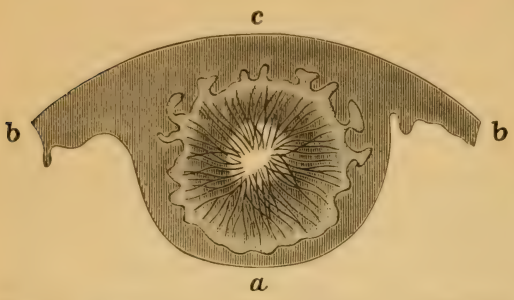


FIG. 47.—Formation of decidua completed. *a*, decidua reflexa ; *b*, decidua vera ; *c*, decidua serotina.

The folds of mucous membrane which inclose the ovum are termed the *decidua reflexa.*

The space between the decidua vera and reflexa is filled by opaque, viscid mucus.

The Placenta —The villi which cover the chorion become imbedded in the soft tissues of the decidua, and derive, by absorption, nutritive materials from the circulatory system of the mother. After the formation of the permanent chorion, by the extension of the allantois to the inner surface of the egg, the allantoic vessels convey the absorbed materials directly to the embryo. At first, absorption takes place from the entire circumference of the chorion, but with the enlargement of the ovum there ensues a thinning of the reflexa, with obliteration of its vessels. At the same time the villi cease to grow over that portion of the chorion in contact with the reflexa, and the whole process of exchange between fœtus and mother becomes concentrated at the decidua serotina. At this point the chorion, in place of becoming bare, is covered with an infinite multitude of villi, which enlarge, lengthen, and, by sending out lateral offshoots, assume an arborescent appearance. The villi are arranged in tufts, sixteen to twenty in number, which together form a soft, spongy mass, and constitute the fetal portion of the placenta.

The uterine mucous membrane, in which the villi lie imbedded, contributes likewise its share to the make-up of the completed pla-

* Leopold, in his account of the uterine mucous membrane, adopts Reichert's view of the formation of the reflexa, viz., that, owing to the less rapid increase in the growth of the serotina, the ovum becomes buried in the thickening of the vera. —(*Vide* Studien über die Uterusschleimhaut, etc., Arch. f. Gynæk., Bd. xi, p. 455.) In opposition to the accepted view that the decidua is the tumefied mucous membrane, Ercolani (On the Utricular Glands of the Uterus, translated by Marcy) insists that both the vera and reflexa are organs of new formation, the products of exudations, the neo-formative process consisting in the production of new vessels with single endothelial walls, from the surface of which the decidual cells are elaborated.

centa. The structure of this so-called maternal portion of the organ has been the subject of much difference of opinion. Indeed, an intelligible idea of its anatomy can hardly be conveyed without a preliminary consideration of certain points connected with its development.

Thus, the villi are often erroneously described as penetrating directly into the glandular structures of the adjacent uterine mucous membrane. Professor Turner has, however, conclusively shown that, in all the less complicated placental forms throughout the animal kingdom, the depressions or crypts into which the villi dip occupy the soft, pulpy, interglandular tissues. Engelmann further draws attention to the large size of the terminal sprouts of the villi in the human placenta, which would render their entrance into the glandular tubules, unless by a mere exceptional chance, a mechanical impossibility. Moreover, Friedländer * has demonstrated, as will be again noted hereafter, the persistence of the enlarged flattened glands in the serotina even after the separation of the placenta at childbirth. It may be deemed, therefore, as fairly settled that the maternal portion of the placenta is derived from the tissues occupying the spaces between the glands, and not from the glands themselves.

In the *mare*, the relations of the villi to the uterine mucosa are of the simplest character. With a little force it is possible to draw the villi from the crypts, which, on vertical section, are seen to be cup-like depressions between the glands. The crypts are surrounded by a dense capillary plexus, and are lined by epithelial cells. The epithelial cells are partly columnar, like those covering the mucous membrane of the uterus in the unimpregnated state, while others are so swollen out that their length but little exceeds their breadth, while others are of irregular shape. Transitional forms prove the derivation of the irregularly shaped cells from ordinary columnar epithelium.†

In the arrangement just described, it will be seen that the villi containing the vessels communicating with the fœtus dip into crypts in the uterine mucous membrane. The crypt-walls are highly vascular, and are lined with epithelium. There is, therefore, no direct communication between the fetal and maternal blood-vessels. The crypts, however, elaborate a secretion, termed by Haller uterine milk, which contains fatty, saline, and albuminous matters dissolved in water. The uterine milk is, therefore, well qualified to serve as a nutrient mate-

* Friedländer, Untersuchungen über den Uterus, 1870—Ueber die Innenfläche des Uterus post partum, Arch. f. Gynæk., Bd. ix, p. 22, 1876. Friedländer's observations have been confirmed by Kundrat and Engelmann, Langhans, and Leopold.

† Professor Turner, The Structure of the Placenta, Jour. of Anat. and Physiol., vol. x, p. 136.

rial, and is without doubt absorbed by the villi for the benefit of the fœtus.*

In the *cat*, the villi of the chorion have the form of broad, sinuous leaflets, which, about the completion of one half the period of gestation, are so interlocked with the crypts that the two surfaces can not be disengaged from one another. Vertical sections show that the walls of the crypts closely follow the sinuosities of the villi in such wise as to form an intimate investment for them. Injections of the maternal capillaries show them to be dilated to two or three times the size of the capillaries in the fetal villi.†

In the *human* placenta the relations of the villi to the uterine mucous membrane differ somewhat at different stages of development.

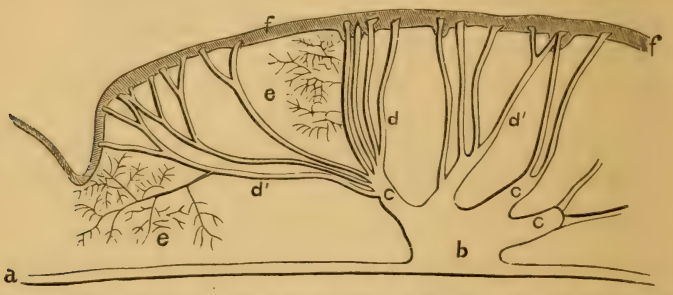


FIG. 48.—Diagram showing the branching of the villi and the connection of the larger trunks with the placenta. *a*, chorion; *b*, primary trunk, with radiate branches (*c*); *d*, the tertiary branches, which either directly, or after previous division (*d'*), penetrate the placenta materna (*f*). The free terminal tufts (*e*) are indicated only at a few points. (Langhans.)

Thus, *at first*, the empty cylindrical villi simply sink into the soft, pulpy, interglandular spaces. *Next*, as the villi sprout and become vascular and arborescent, projections formed from the proliferation of the superficial portion of the serotina grow around the offshoots and branching processes. At this time we distinguish in the placenta a fetal portion, the *placenta fœtalis*, composed of the villous tufts of the

* The uterine milk can not be obtained from the placenta of the mare unmixed with the secretions from the uterine glands. The analyses of Professors Prevost, Schlossberger, and Gamgee were made upon a fluid derived from polycotyledonous placentæ.—(*Vide* Structure of the Placenta, p. 176.) HOFFMANN (Sicherer Nachweis der Uterinmilch beim Menschen. Ztschr. f. Geburtsk. und Gynaek, Bd. vili, p. 258) claims to have demonstrated the presence of uterine milk in the human placenta likewise. This he obtained by the insertion of capillary tubes into the substance of the placenta from its maternal surface. The fluid consisted of serum, of some of the formed elements of the blood, and of a multitude of spherical bodies which he regarded as analogous to milk globules. WERTH, however (Ueber die sogenannte Uterinmilch des Menschen, Arch. f. Gynaek., Bd. xxii. p. 233), has shown that this so-called uterine milk is a post-mortem production, not present directly after delivery; that the serous portion is derived from the villi, and the formed elements from the exochorial cells.

† TURNER, *op. cit.*, pp. 155, 156.

ovum, and a uterine portion, the *placenta uterina*, derived from the tissues of the serotina.

In the third and fourth months the union of the fetal and maternal tissues is very intimate. But subsequently the growth of the uterine tissue does not keep pace with that of the villi, so that the mature placenta is almost altogether a fetal organ. A layer of uterine mucosa, not exceeding $\frac{1}{25}$ of an inch in thickness, covers the surface of the placenta after delivery. Between the cotyledons, however, thin partitions from the serotina extend downward for a considerable distance, though never, except near the borders, as far as the chorion.

Sections through the hardened placenta show that the main villous trunks divide at a short distance from the chorion. The secondary branches assume a radiate direction, from which proceed tertiary branches, which terminate in club-shaped extremities and bury themselves in the serotina. From these tertiary branches fine lateral ones, having a dendritic arrangement, are given off, and fill the spaces between the tertiary trunks.

Many of these lateral tufts are attached directly to the serotina, and fill up in part the interval between the larger radiate branches; others, again, float freely in the blood-currents derived from the maternal vessels.*

The precise origin and nature of the vascular spaces between the villi have been a prolific subject of discussion. In the early months, we saw, the serotinal projections extended deep down between the villi, and contained largely dilated capillaries; and yet afterward every trace of these vessels is found to have disappeared throughout the entire placenta, except in the thin layer of the placenta uterina, where the endothelium, or inner lining, may still be detected. The most probable supposition is, that the vessels have become eroded and finally destroyed by the growth of the villi, leaving the blood to flow unimpeded through the intervillous spaces. A delicate layer of epithelium may, indeed, be found upon the villous trunks and tufts; but these, it is sufficiently established, belong to the villi, and are derived from the exochorion.† Whether these cells essentially modify the interchange between the fetal and maternal circulations, can only be a matter of conjecture. The fact that certain medicinal substances, such as iodide of potassium and salicylic acid, when administered dur-

* Langhans, Zur Kenntniss der menschlichen Placenta, Arch. f. Gynaek., Bd. i, 1870, p. 317; *vide* also Kölliker, Entwickelungsgeschichte; Leopold, Der Bau der Placenta, Arch. f. Gynaek., Bd. xi, 1877, p. 443.

† Kölliker, Entwickelungsgeschichte, 2te Auflage, p. 333; Leopold, Der Bau der Placenta, Arch. f. Gynaek., Bd. xi, p. 467. It is, however, proper to state here that Ercolani maintains that the dilated endothelial walls of the maternal vessels are simply bent inward by the proliferating villi, and that the epithelium observed upon the villi are decidual, and are not derived from the exochorion. *Vide* Marcy, N. Y. Med. Journal, July 28 and Aug. 4, 1883.

ing the latter days of pregnancy, may be found in the blood and secretions of the fœtus, whereas others, as woorari and perhaps mercury, have not been so found, renders some action on the part of the cells, aside from simple osmosis, at least probable.*

The Structure of the Fully-developed Placenta.—The placenta, after its removal from the body, is found to be a soft, spongy mass, of a

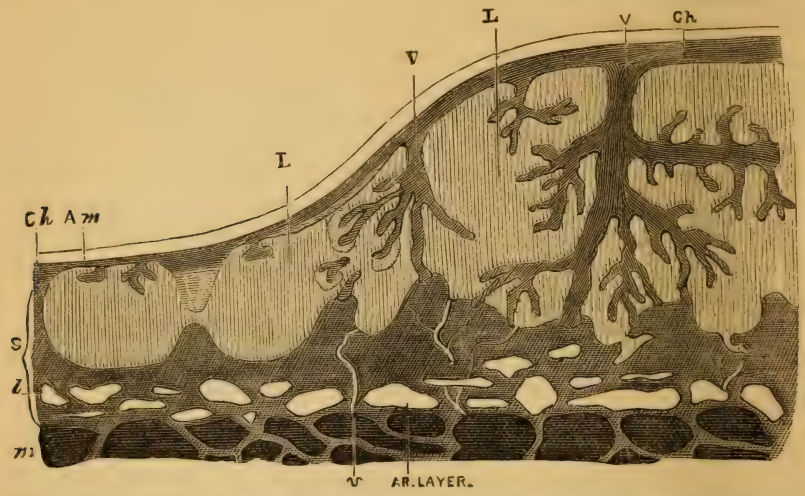


FIG. 49.—Diagram of uterus and placenta in the fifth month. *Ch*, chorion; *Am*, amnion; *V*, villi; *L*, lacunæ; *S*, serotina; *AR*, areolar; *V*, small arteries. (Leopold.)

somewhat oval shape. It measures upward of seven and a half inches in its longest diameter, is from two thirds to an inch in thickness at the point of insertion of the funis, and weighs about sixteen ounces. Its internal surface is smooth, and is covered by the amnion, through which the vessels communicating with those of the funis can be seen

* *Vide* FEHLING, Zur Lehre der Stoffwechsel, Arch. f. Geburtsk., Bd. ix. p. 313; BENEKE, Ztschr. f. Geb. und Frauenkrankheiten, Bd. i. p. 477; GUSSEROW, Arch. f. Geburtsk., Bd. iii. p. 241; SCHAUENSTEIN und SPAETH, Jahrb. der Kinderheilk., 2ter Jahrg., p. 13; R. HEINZ, Arch. f. Gynaek., Bd. xxxiii. p. 413; Untersuchungen über den Bau und die Entwickelung der menschlichen Placenta. Heinz states that on the borders of the placenta a portion of decidual tissue is pushed under the placenta (2 to 3 cm.), and at this point septa may be found penetrating the placenta to the subchorial layer of the decidua. Detached portions of decidual tissue sometimes are found in placental tissue. At term the villi have no epithelial covering. In the early months cell coverings may be seen here and there, but are derived from the villi. The remains of glandular structures described by Friedländer, after separation of decidua, are not found in the serotina at the end of pregnancy. The separation must therefore take place from the borders in the puerperal period, when the point at which placental separation has taken place is of small size. Heinz observed specific instances where the villi penetrated directly into the lumina of the decidual glands, but leaves open the question whether they likewise penetrate into the interglandular tissue. Heinz's view of placenta formation is as follows: Villi

in their distribution over the surface of the organ previous to plunging into the tissues beneath. The uterine surface has a peculiar, granular feel, and is divided into a number of lobes, corresponding to the fetal tufts or cotyledons already described. It is covered with a soft, thin membrane, which sends septa or partitions in between the cotyledons. This membrane is simply the product of the surface layer of the serotina.

Curled arteries from the uterus penetrate the cotyledons, and convey the maternal blood into the spaces or lacunæ between the fetal tufts. Through these spaces the blood flows in a sluggish current, and is conveyed back to the uterus by the coronary vein upon the margin of the placenta, and by means of sinuses situated in the septa between the cotyledons, and continuous with the venous sinuses of the uterine walls.* The fetal tufts which thus bathe in the mother's blood receive, through the umbilical arteries, the blood which comes from the fœtus, darkened with carbonic acid. In the ultimate ramifications of the villi, the arteries communicate by an arch or loop with a corresponding branch of the umbilical vein, which returns to the child red, arterialized blood.†

But the placenta is not simply a respiratory organ. The rapid development of the ovum, from a simple cell of microscopic size to the proportions of the infant at birth, argues as surely that the relations of the blood-currents in the placenta enable the fœtus to derive from the mother all the proximate principles required for the building up of tissue, the differentiation of organs, and the performance of function.

Then, too, the fœtus has been shown to have a temperature of its own, somewhat higher than that of the mother.‡ This production of heat is necessarily attended with destruction of tissue. Of this there

penetrate the decidua and chiefly enter gland structures, break through the gland walls, and destroy maternal tissue, with the exception of small remnants, which persist as islets. Villi grow into dilated vessels, and bathe freely in them. The opened vessels pour the blood into the intervillous spaces. In the mature placenta there remains of decidua only the serotina, one half to one millimetre thick. The septa and the islets are evidence that serotinal tissue once existed near the chorion, but was destroyed by growth of villi.

* For affirmative evidence of the existence of placental lacunæ, *vide* Professor Turner, Structure of the Human Placenta, Jour. of Anat. and Physiol., vol. vii, p. 120. So, too, Professor Dalton's ingenious inflation of the intervillous spaces with air, Treatise on Human Physiology, 1867, p. 615. For objections, the elaborate paper of Braxton Hicks, in the London Obstet. Trans., vol. xiv, deserves careful perusal.

† *Vide* experiments of Zweifel, Die Respiration des Fœtus, Arch. f. Gynaek., Bd. ix, p. 292. See also Bérard, t. iii, p. 422, experiments of Legallois.

‡ Wurster, Ueber die Eigenwärme der Neugebornen, Berl. klin. Woch., Nr. 87, 1869; Alexeef, Ueber die Temperatur des Kindes im Uterus, Arch. f. Gynaek., Bd. x, p. 141.

is evidence in the presence of urea in the bladder and the amniotic fluid. There can be little question, however, but that the placenta furnishes the chief channel through which the devitalized products are discharged.

The Formation of the Umbilical Cord.

To understand the structure of the cord, it is well to bear in mind the various particulars connected with its development. At the time when the allantois first appears as a sac-like projection from the intestine, the embryo is hardly more than an appendage to the umbilical vesicle. The larger size of the latter directs the allantois over the posterior extremity of the fœtus. By its growth and extension, the

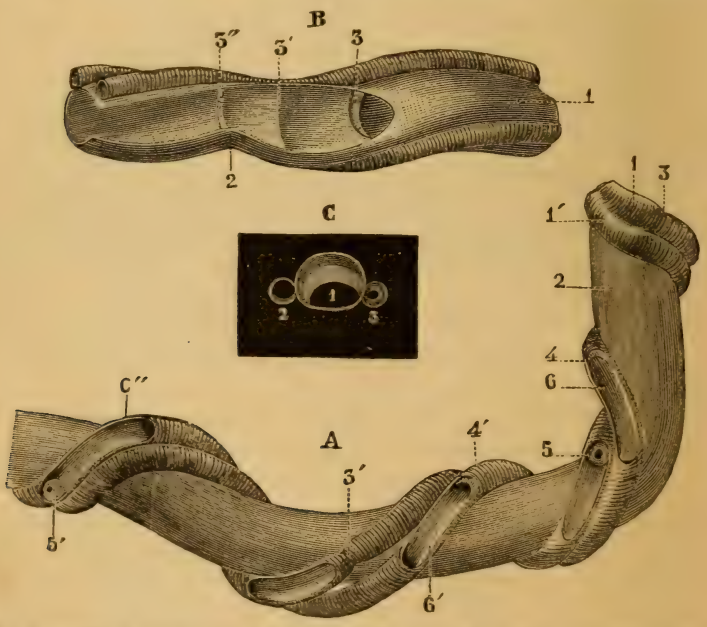


Fig. 50.—A, umbilical arteries forming spirals (1, 1′) around the vein; constrictions indicating the presence of folds (3, 3′); circular folds (5, 5′); lateral openings showing the arterial walls. B, vein opened upon the side, showing a constriction (2) corresponding to an interior valve (3″); semi-lunar valves (3, 3′, 3″) C, section of vein and arteries showing valve of vein (1), a semi-lunar arterial valve (2), and a circular arterial valve (3). (Tarnier et Chantreuil.)

allantois reaches the chorion, and forms a sort of pedicle, by means of which a vascular communication is established between the embryo and the periphery of the ovum. This pedicle is the first indication of the umbilical cord. Its vessels become reduced to two arteries, the umbilical arteries, and a single vein, the umbilical vein. Meantime, the umbilical vesicle diminishes in size, and finally shrinks to a mere thread. The amnion fills with fluid, exuded probably from the body of the fœtus, and continues to expand, so that often by the end of the

second month it comes in contact with the chorion.* In this way it forms a reflection over the pedicle of the allantois, which it invests like the finger of a glove. Finally, the structure of the cord is completed by the formation of an elastic substance, termed the *gelatine of Wharton*, which consists of connective-tissue elements inclosing large spaces containing amorphous matter. The gelatine of Wharton functionally serves to protect the vessels of the cord from compression. It is formed by hypergenesis from the outer layers of the amnion and the allantois, both of which are derived from the intermediate layer, described in the development of the fœtus (*vide* p. 50). The intermediate layer furnishes, likewise, the connective tissue of the body.

The fully-developed cord consists, therefore, of a sheath from the amnion, the gelatine of Wharton, the umbilical vein and arteries, and traces of the umbilical vesicle,† and the pedicle of the allantois.‡ It averages twenty inches in length, though it has been observed as long as seventy inches, and as short as two and a half inches.# A long cord predisposes to the formation of coils about the neck, body, and limbs of the fœtus. It is usually of about the size of the little finger, but is very variable, its circumference depending chiefly upon the quantity of the gelatine of Wharton. The arteries are so twisted as to form spiral turns around the vein, and, owing to the superior length of the right artery, in most cases in the direction from right to left. As an anatomical peculiarity, may be mentioned the fact that the walls of the arteries are only slightly thicker than those of the vein. The arteries as well as the vein contain semi-lunar valves.

The Amniotic Fluid.—The origin of the amniotic fluid in the earlier months of gestation is not known, the most probable suggestion being that it is simply exuded from the tissues of the fœtus. After the formation of the placenta, a capillary network, connected with the vessels of the umbilical cord, is developed just beneath the amnion in that portion of the chorion which covers the placenta. From these vessels a transudation of serum takes place into the cavity of the amnion.‖ After the first half of pregnancy has been reached, the capillary network disappears. The continued increase of fluid in the amnion in the later months of gestation is possibly due to the accumulation of urine, which the fœtus passes intermittently during intrauterine existence.^ The composition of the amniotic fluid corresponds

* *Vide* Hunter's Gravid Uterus, plate xxxiii, Fig. 2; Ecker, Icon. Physiolog., plate xxxiii, Fig. 7.

† Schultze, Das Nabelbläschen, ein constantes Gebilde, etc., Leipsic, 1861.

‡ Ahlfeld, Die Allantois des Menschen, Arch. f. Gynaek., vol. x, p. 81.

Chantreuil, Des Dispositions du Cordon, Paris, 1875.

‖ Jungbluth, Beitrag zur Lehre vom Fruchtwasser, Inaug. Dissert., Bonn, 1869.

^ Gusserow, Zur Lehre vom Stoffwechsel des Fœtus, Arch. f. Gynaek., vol. iii, pp. 268, 269. Prochownick, Beiträge zur Lehre vom Fruchtwasser und seiner Entstehung, Arch. f. Gynaek., vol. xi, p. 304. Kruckenberg, Kritische und experi-

to its double origin. In addition to water it contains albumen, urea, and the saline substances which are found in serum and urine. Its quantity varies usually between one and two pints, of which nearly one half is contributed during the last three lunar months.*

Ahlfeld concludes from the great quantities of lanugo found in the meconium that the child of necessity during intra-uterine life swallows a very considerable quantity of amniotic fluid. As no fluid is found at birth in the intestinal canal, the fluid was of necessity absorbed. As the amniotic fluid contains albumen, in certain cases the precipitate amounting to from twenty-five to fifty per cent, he believes this albuminosus contributes something to the nourishment of the child. Richard Schroeder, on the contrary, regards the quantity of albumen in the amniotic fluid as too small to contribute appreciably to fetal nutrition.

CHAPTER III.

DEVELOPMENT OF THE FŒTUS.

Development of the fœtus in the successive months of pregnancy.—Fetal circulation.—Fœtus at term.—Fetal cranium.—Attitude, presentation and position of fœtus.

Development of the Fœtus in the Successive Months of Pregnancy.

It is customary to reckon the duration of pregnancy at two hundred and eighty days, and to divide that space into ten months of twenty-eight days each. As it is often a matter of importance that an accoucheur should be able to judge the age of a prematurely expelled embryo or fœtus, the following particulars concerning the changes in each month are furnished as a guide to the formation of an opinion. In the writer's experience all rules regarding the age of the ovum possess, however, nothing more than an approximative value, owing to the very great normal variations in the rapidity of development in different individual cases.

First Month.—At the end of the second week, the embryo is represented by the embryonic spot, which has assumed a biscuit-shape. The dorsal plates are developed. The entire ovum measures one fourth of an inch, and the embryo one twefth of an inch. A week later the embryo has doubled in length, and presents as special features a curv-

mentelle Untersuchungen ueber die Herkunft des Fruchtwassers, Arch f. Gynaek., vol. xxii, p. 1.

* Gusserow, *l. c.*, p. 269. F. Ahlfeld, In Wie Weit das Fruchtwasser ein Nahrungsmittel für die Frucht ist, Zt. f. Geb. und Gynaek., vol. xiv, p. 405.

ing of the back, an enlargement of the cephalic extremity, with rudiments of the three higher organs of special sense, and the appearance of the visceral arches. The amnion is fully developed. The embryo is nourished by the umbilical vesicle. The allantois carries the vessels from the embryo to the periphery of the ovum, but the vessels do not penetrate the villi. An ovum described by Waldeyer, exactly four weeks old, was of about the size of a pigeon-egg, and three fourths of an inch long by two thirds of an inch broad. It weighed upward of two scruples. The embryo measured nearly one third of an inch in

FIG. 51.—Human germs or embryos from the second to the fifteenth week (natural size), seen from the left side, the arched back turned toward the right. (Principally after Ecker.) II, human embryo of fourteen days; III, of three weeks; IV, of four weeks; V, of five weeks; VI, of six weeks; VII, of seven weeks; VIII, of eight weeks; XII, of twelve weeks; XV, of fifteen weeks.

length, or four fifths of an inch in length following the dorsal curvature from the top of the cephalic extremity to the end of the coccyx. The head of the embryo presented the primitive cerebral vesicles. The eyes were in the sides of the head, and the ears posterior to the eyes. Beneath, the visceral arches were well marked. Four bud-like processes indicated the beginnings of the anterior and posterior extremities. The intestine, with anal and oral openings, was formed. The cord was short and thick, with a single vein and two arteries. The amnion was only moderately distended, and space still existed

between the amnion and chorion The umbilical vesicle was tolerably large.

Second Month.—An embryo described by Waldeyer from the sixth to the seventh week measured about one inch in length, following the dorsal curve. Another in the eighth week described by Ecker measured two thirds of an inch in a direct line from the head to the caudal curve.* The ovum itself was of about the size of a hen's egg. The amnion at the end of the second month is distended with fluid and in contact with the chorion.† The villi become abundant near the implantation of the umbilical cord. The umbilical vesicle is greatly reduced in size, and hangs from the embryo by a slender pedicle. The umbilical cord is increased in length, but its vessels do not yet assume a spiral direction. The umbilical ring is small, though still containing loops of intestine. Ossification begins in the lower jaw and clavicle. The three divisions of the extremities are clearly indicated.

Third Month.—Toward the end of the third month the ovum measures nearly four inches in length. The embryo is between three and three and a half inches long, and weighs about an ounce. The chorion has lost in great measure its villosities. The placenta is formed, though of small size. The cord lengthens, and forms spiral turns. The neck now separates the head from the trunk The development of the ribs distinguishes the thorax from the abdomen. The mouth is closed by the lips, and the nasal separated from the oral cavity by the palate. Points of ossification appear in most of the bones. Thin, membrane-like nails appear upon the fingers and toes. The scrotum and labia majora begin to form from cutaneous folds. The penis and clitoris do not differ from one another in length.

Fourth Month.—Toward the end of the fourth month there is an increase of size and thickness in the placenta. The cord is increased to two or three times the length of the fœtus, and has become thicker from the formation of the gelatine of Wharton. The fœtus measures four to six inches in length. The weight is estimated all the way between two and four ounces. The head of the fœtus is one fourth the length of the entire body. The bones of the skull are partly ossified. The sutures and fontanelles are widely separated. The mouth, eyes, ears, and nose assume their proper shape. The sex is distinguishable, the skin firmer, and hair begins to form upon the scalp. The fœtus makes slight movements with its limbs.

Fifth Month.—The fœtus measures from seven to ten inches in length, and weighs nearly ten ounces. The head is still relatively large. The face, however, is wrinkled, and wears a senile aspect. Fine hair (lanugo) appears over the whole surface of the body. The fetal movements are now distinctly felt by the mother.

* Spiegelberg, Lehrbuch der Geburtshülfe, p. 84.

† *Loc. cit.*, p. 84.

Sixth Month.—Near the end of the sixth month the fœtus is eleven to thirteen inches long and weighs about twenty-three ounces. The deposition of fat in the subcutaneous cellular tissue begins. The eyelids separate. A fœtus born at this time breathes feebly, but in the course of a few hours dies.

Seventh Month.—The fœtus measures fourteen to fifteen inches, and weighs in the neighborhood of thirty-nine ounces. The skin is still wrinkled, of a red color, and covered with vernix caseosa. Children born between the twenty-fourth and the twenty-eighth week move their limbs and cry feebly at birth, but in spite of every care they die in the course of a few hours or days.

NOTE.—Ahlfeld has recently suggested the inquiry as to whether the assumption that children born before the completion of the twenty-eighth week necessarily perish is not too arbitrary. Many practitioners have observed instances of the survival of a premature child which, both from the data obtained from the parents and from all the indications presented by the child, they at the time of birth had placed within the limit regarded as hopeless. Ahlfeld has culled a number of such cases from the published literature of the subject. Granting the many sources of error which would lead us to accept such cases with caution, it none the less seems incumbent upon us to regard Ahlfeld's advice, and look upon every child which respires at birth as one whose life may possibly be preserved by suitable care. It may be that the skepticism of medical men is in part the cause of the unfavorable results.*

Eighth Month.—The fœtus measures sixteen to seventeen inches, and weighs upon the average about fifty-two ounces. The pupillary membrane disappears; the hair of the head increases in thickness; the lanugo begins to disappear from the face; the nails are harder, but do not yet reach the tips of the fingers. Usually, in boys, a testicle may be felt in the scrotum; the navel is situated nearly in the center of the child's body. With care, the life of a child born within this period may be preserved.

Ninth Month.—The length is between sixteen and a half and seventeen and a half inches; the weight is about sixty-four ounces; the body becomes rounded and the face more comely, losing its wrinkled, antiquated aspect; the bones of the head bend easily, and the lanugo begins to disappear from the body. Children at this period are less energetic than at full term, sleep a great part of the time, and are prone to die with lack of careful attention.

Tenth Month.—In the first two weeks the fœtus measures eighteen to nineteen inches, and weighs about seventy-seven ounces.†

* AHLFELD, Ueber unzeitig und sehr frühzeitig geborene Früchte die am Leben blieben, Arch. f. Gynaek., Bd. viii, p. 194.

† The weights and measures are taken from Hecker's averages, based on 486 observations. (*Vide* Monatsschr. f. Geburtsk., Bd. xxvii, 1866.)

Observations of Fesser showed similar results. (Lehrbuch der Geburtshülfe, von OTTO SPIEGELBERG, 1877, p. 86.)

Ahlfeld obtained considerably larger averages from 250 observations in which

For convenience of reckoning from memory it is sufficiently accurate to assume the length of the child in the third and fourth month at respectively three and four inches. In the fifth, sixth, seventh, and eighth months close approximations to the average length may be obtained by doubling the number of months. In the ninth and tenth months the length may be placed respectively at seventeen and eighteen inches.

The Fetal Circulation.—The umbilical arteries at first take their origin from the inferior vertebral arteries, and afterward from the hypogastric or internal iliac arteries.

The umbilical vein enters the abdomen at the navel, and thence passes to the lower surface of the liver; it gives off a number of branches to the left lobe, the lobus quadratus, and the lobus Spigelii. At the transverse fissure it divides into two branches, the larger of which empties directly into the portal vein, and supplies the right lobe with umbilical blood; the other passes to the inferior vena cava, and is termed the *ductus venosus*. Thus the greater portion of the regenerated blood, brought by the umbilical vein from the placenta, first passes through the liver before entering the general circulation of the fœtus, while the lesser amount empties at once into the inferior vena cava. As, however, with the advance of gestation, the relative disproportion between the hepatic trunks and the ductus venosus is increased, toward the end nearly all the blood from the placenta has to make the circuit of the liver.

Thus the inferior vena cava carries to the right auricle, in part, blood from the lower extremities charged with effete matters, and, in part, placental blood, either received direct from the umbilical vein through the ductus venosus, or after having previously traversed the liver.

In the fœtus the currents of blood through the heart are especially adapted to the unexpanded condition of the pulmonary organs. Previous to the first respiratory act at birth, the lung is small, and, were the entire contents of the right side of the heart, as in the adult, at once discharged into the pulmonary vessels, intense engorgement with rupture of the capillaries would ensue. This danger is, however, averted by the anatomical peculiarities already stated. Thus, in the early months the blood from the inferior cava, in place of emptying from the right auricle into the right ventricle, passes directly across the right auricle, guided by the Eustachian valve, through the foramen ovale to the left auricle, and thence to the left ventricle. As the heart contracts it enters the aorta, and is distributed by the large vessels which spring from the latter to the head and upper extremities. The blood returned from the upper portion of the body by the superior

the date of conception could be determined. (Bestimmungen der Grosse und des Alters der Frucht vor der Geburt, Arch. f. Gynaek., ii, 1871, p. 361.)

vena cava enters the right auricle, where it passes in front of the Eustachian valve into the right ventricle. A commingling of the currents from the superior and inferior venæ cavæ in the right auricle

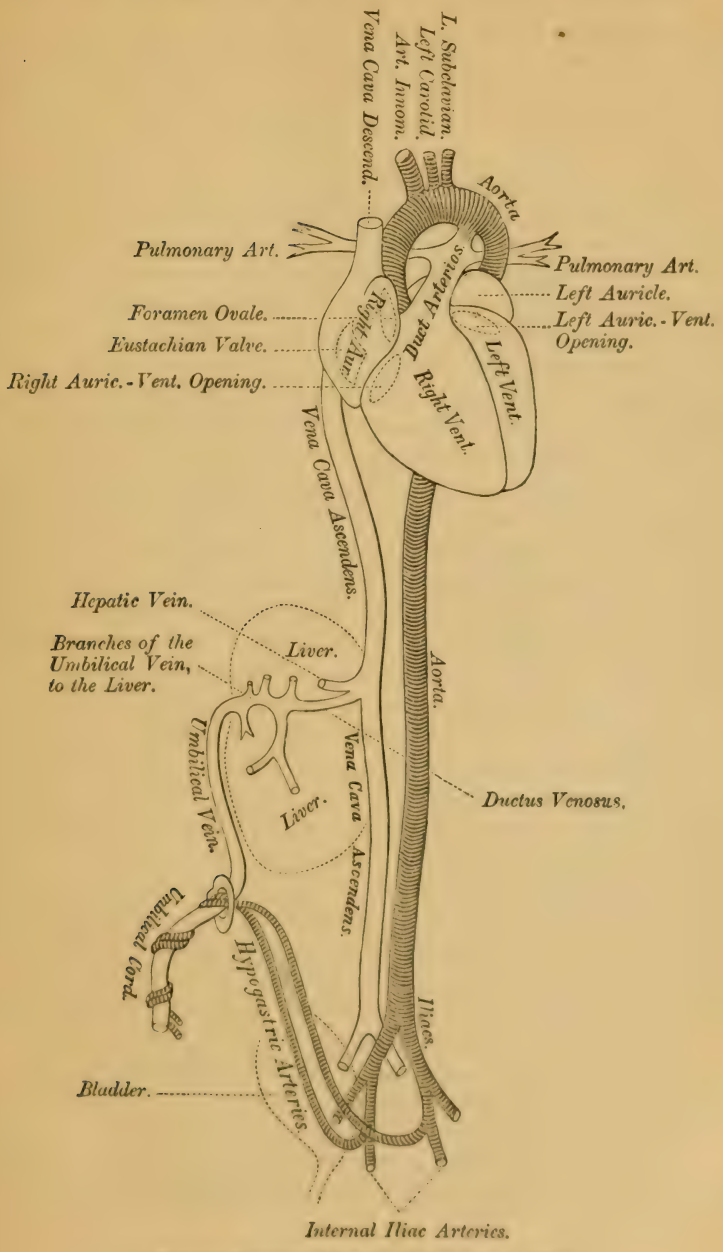


FIG. 52.—Diagram of the fetal circulation. (Flint.)

is almost completely prevented in the earlier months by the Eustachian valve. With the advance of gestation, however, a gradual disappearance of the Eustachian valve takes place, so that a part of the blood from the inferior cava enters with that of the superior cava into the right ventricle. The contraction of the right ventricle forces the blood into the pulmonary artery, which distributes an insignificant quantity to the lungs, while the main current passes through the ductus arteriosus into the aorta, by which it is distributed to the lower portion of the body.

Thus it will be noted that at all times provision is made for supplying the head and upper parts of the body with regenerated placental blood. On the other hand, the lower extremities are for a time almost entirely supplied with blood which has already fed the tissues and received the waste of the upper portion of the body. As pregnancy, however, advances with the disappearance of the Eustachian valve, a small measure of placental blood is likewise distributed to the lower portion of the body. This is in unison with the well-known fact that the relative development of the lower extremities increases as the end of gestation is approached.

With the cessation of the placental circulation at birth, the umbilical vessels close, with the exception of the umbilical arteries, which remain pervious at their lower portion and constitute the vesical arteries. After the establishment of respiration, the blood from the right side of the heart makes the circuit of the lungs and returns to the left side by the pulmonary veins. The ductus arteriosus then contracts and disappears. As the left auricle fills with blood, the pressure closes the valve of the foramen ovale. Occasionally, however, the foramen ovale remains open after birth, and allows a portion of the venous blood to pass from the right to the left auricle. We have then one form of the condition known as *cyanosis neonatorum*, an affection characterized by intermittent attacks of dyspnœa, blueness of the surface of the body, and depression of the temperature.

The Fœtus at Term.—In the child at birth the body is well rounded, and the skin has lost its deep-red coloring; the fine down (lanugo) has, for the most part, disappeared; the nails project beyond the finger-tips; in the male the scrotum contains both testicles, and in the female the labia majora are in contact. In the fifth month the surface of the fetal body is covered by the *vernix caseosa*, a whitish substance composed of a commingling of surface epithelium, down, and the products of the sebaceous glands. This coating probably protects the skin during intra-uterine life from the penetration of the amniotic fluid. The amount of this substance upon the body is very variable at birth, when it is chiefly found upon the back and flexor surfaces of the extremities.

Children at term cry lustily soon after birth, move their limbs

freely, and nurse when put to the breast. In the first few hours they pass urine and the so-called *meconium*, a mixture of intestinal mucus with epithelium, epidermis cells, lanugo, and bile, which gives to it a black or brownish-green color.*

The average length at birth is from twenty to twenty-one inches. The average weight seems to be, in some degree, dependent upon race peculiarities. Scanzoni † found, in nearly 9,000 births, an average for both sexes of nearly seven pounds. Ingerslev,‡ in Copenhagen, from statistics based upon 3,450 births, arrived at nearly the same results. Hecker,# in Munich, out of something over 1,000 births, obtained six and four fifths pounds as the average; while Fesser, ‖ in Breslau, found it only six and a half pounds. Bailly ^ likewise reports the average weight as something less than seven pounds. The weights of 200 infants born in the Bellevue Hospital gave to the writer an average of seven and two thirds pounds for the two sexes. The boys averaged seven and nine tenths pounds, and the girls seven and one third pounds. Three fourths of the mothers were of Irish birth, one fifth were born in America, while the remaining fraction was divided between English, Scotch, and Germans. The largest child weighed eleven pounds. Ingerslev's largest child weighed ten and three eighths pounds; Hecker found two weighing between ten and eleven pounds; La Chapelle, out of 7,000 cases, found thirteen infants weighing ten pounds, but none exceeded that limit. Credible histories ◊ of children weighing from twelve to sixteen pounds are extant; such children have often been still-born. Waller, however, ‡ reports a case of a living infant delivered by him with forceps, which weighed fifteen pounds fifteen ounces. I have extracted with forceps a living child which weighed over fifteen pounds. Dr. C. W. Gleavis, of Wytheville, Va., writes me that a lady in that place gave birth to a living male child which weighed eighteen pounds. The size of the child is influenced in especial by—1. The sex. Boys average a greater weight than girls. 2. The number of pregnancies. The children of primiparæ average less than those of multiparæ. The increase in weight of children in each successive pregnancy is progressive, though this law is liable to interruption where pregnancies follow one another too rapidly, or in cases

* Zweifel, Untersuchungen über das Meconium, Arch. f. Gynæk., Bd. vii, 1875, p. 474.

† Scanzoni, Lehrbuch der Geburtshülfe, p. 96.

‡ Ingerslev's On the Weight of New-born Children, Obstet. Jour., iii, 1876, p. 705.

Klinik der Geburtskunde, ii, 1864.

‖ Spiegelberg, Lehrbuch der Geburtshülfe, p. 86.

^ Bailly, Nouveau Dictionnaire, t. xv, art. Fœtus, p. 5.

◊ Naegele's Lehrbuch der Geburtshülfe, bearbeitet von Grenser, 8te Auflage, p. 624.

‡ Waller, London Obstet. Trans., vol. i, p. 309.

in which there is a change of sex. In the latter instance the variation is to the disadvantage of the female born in succession to a male.* 3. The age of the mother. Duncan found the greatest weight in children born of mothers between the twenty-fifth and twenty-ninth years;† Wernich, between the thirtieth and thirty-fourth years.‡ 4. The constitution and health of the parents. By some, too, the size of the father is supposed to exercise an influence upon that of the child.

The Fetal Cranium.—Except in children of exaggerated size, the head is the most voluminous and unyielding part which has to traverse the parturient canal.# The diameters of the head and the physical characters of its bones are chiefly of importance in connection with the mechanism of labor. Their consideration may, therefore, be conveniently postponed to the study of that subject. A knowledge, however, of the general structure of the skull is essential to the diagnosis of pregnancy.

The face is very small in proportion to the cranium. The latter consists of the two frontal bones, the two parietal bones, the occipital bone, the temporal bones, and the alæ of the sphenoid bone. At birth these various bones are not, as in the adult, directly articulated together, but are united by means of fibrous bands, termed *sutures*, in which ossification subsequently takes place. It is important to become familiar with the following sutures: 1. *The frontal suture*, between the frontal bones. 2. *The sagittal suture*, between the two parietal bones. 3. *The coronal suture*, between the frontal and parietal bones. 4. *The lambda suture*, between the occipital and two parietal bones.

When three or more bones meet together, the rounded angles of the bones offer at the point of concurrence a deficiency of osseous substance, which is closed by fibrous membrane similar to that which forms the sutures. These membranous interspaces are termed *fontanelles*. Two of these, the large anterior and the small posterior fontanelle, are of immediate obstetrical interest, as they, with the sutures, furnish the guiding points which enable the examining finger to determine, in advanced pregnancy, the position of the child's head.

The *large fontanelle*, or bregmatic space (bregma, the sinciput), occupies the gap between the parietal and frontal bones. It possesses a lozenge-shape. Its anterior angle is continuous with the frontal suture, its posterior angle with the sagittal suture, and its lateral angles with the two halves which compose the coronal suture. Its anterior angle is much longer than the posterior angle.

The *small fontanelle* is situated at the junction of the occipital with

* Wernich, Ueber die Zunähme der weiblichen Zeugungsfähigkeit, Beitr. zur Geburtsh., Bd. 1. p. 3.

† Duncan, Fecundity, Fertility, and Sterility, p. 53.

‡ *Loc. cit.*, p. 10.

In bulky children, the shoulders sometimes offer the greatest difficulties in delivery.

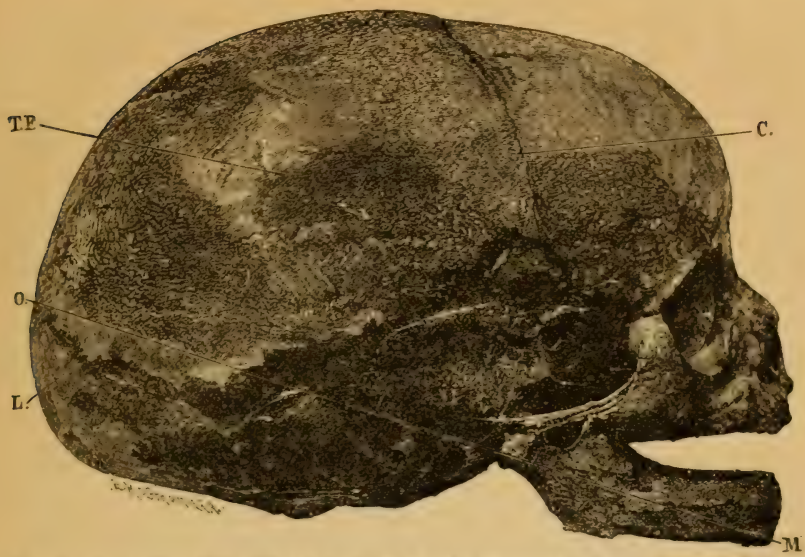


FIG. 53.—Fetal skull, seen from the side. *T F*, tuber parietale; *L*, lambda suture; *O M*, occipito-mental diameter; *C*, coronal suture. (J. Veit.)

FIG. 54.—Fetal skull seen from above. *T T*, bi-temporal diameter; *P P*, bi-parietal diameter. (J. Veit.)

the parietal bones. It is of a triangular shape, and, as its name indicates, of small size. As a rule, it no longer exists at birth, owing to the complete ossification of the angles which form it.

The anterior fontanelle may be recognized by the finger, during labor, by its large size, its lozenge-shape, and by its four converging sutures which cross one another at right angles. The posterior fontanelle, on the contrary, is small and triangular; the sagittal suture forms, with the lambda suture, an obtuse angle on either side, and terminates at the occipital bone. During the descent of the child's head into the pelvis, the occipital bone is frequently depressed beneath the parietal bones, which thus form a relief, along which the finger readily passes to the site of the small fontanelle, even when the latter no longer exists as an open gap or space.

The Attitude, Presentation, and Position of the Fœtus.

The attitude of the fœtus *in utero* is as follows: The spinal column is bent forward, the chin is inclined toward the chest, the arms are bent at the elbow and the forearms are crossed upon the breast, the thighs are flexed upon the abdomen, and the feet extended so as to come in contact with the legs, which, like the forearms, are often crossed. By this arrangement the fœtus assumes the smallest bulk, and presents an ovoid form, of which the head furnishes the smaller end.

By *presentation* we understand that portion of the fœtus which occupies the lower segment of the uterus. By the determination of the presentation, we are enabled to decide upon the relation of the axis of the child to the long diameter of the uterus. When these two coincide, either of the two extremities of the child, viz., the head or the breech, becomes the presenting part. When the long diameter of the child corresponds to the oblique or transverse diameter of the uterus, the shoulder becomes the presenting part.

Though head-presentations form, during labor, by far the large majority of all cases (ninety-six per cent.), changes of position are very common during pregnancy. The frequency of these changes is in inverse ratio to the advance of pregnancy, occurring with diminished frequency in the later months. In multiparæ they take place oftener than in primiparæ. In multiparæ they occur not rarely shortly before birth, while it is exceptional in primiparæ for them to take place in the last three weeks of pregnancy. Great ingenuity has been exercised to account for the preponderating frequency, at the time of labor, of head-presentations. Hippocrates taught that, during the early months of pregnancy, the fœtus occupied a sitting posture, with the head uppermost. In the seventh month, however, it made a complete turn or somersault preparatory to its exit from the womb, an act

accomplished by the voluntary efforts of the child. Aristotle referred the head-presentations to the laws of gravity, a theory which has always had many adherents and is still actively defended at the present day.*

Dubois † made a serious breach in this doctrine by showing that if he allowed a dead fœtus, of any period between the fourth and ninth months, to sink in a vessel filled with water, it was not the head, but the back or right shoulder which first reached the bottom. Dubois thereupon denied the influence of gravity, and referred the head-presentations to instinctive or voluntary movements on the part of the fœtus, designed to bring it into a position best adapted for intrauterine domicile, or for parturition. He likewise argued against the gravitation theory, that in premature births, and in children who die *in utero*, pelvic and transverse presentations are very common—a fact that would be inexplicable were gravity the sole or chief force in operation. Simpson ‡ agreed with Dubois in ascribing the cephalic presentations to fetal movements, but, in place of the instinctive or voluntary movements of Dubois, substituted, in an argument of extraordinary ingenuity, a theory of reflex action. Thus, the frequency of mal-positions in the first six months of pregnancy was explained by the spheroidal shape of the uterine cavity, which allows of unrestrained fetal movements. In the later months, however, as the uterus assumed a more ovoid shape, it was only when the child was situated in the uterus with the head lowest that a physical adaptation between fœtus and uterus existed. In case from any cause, therefore, a deviation from this, the normal position, took place, the pressure upon the cutaneous surface of the child, by the uterine wall, would give rise to excito-

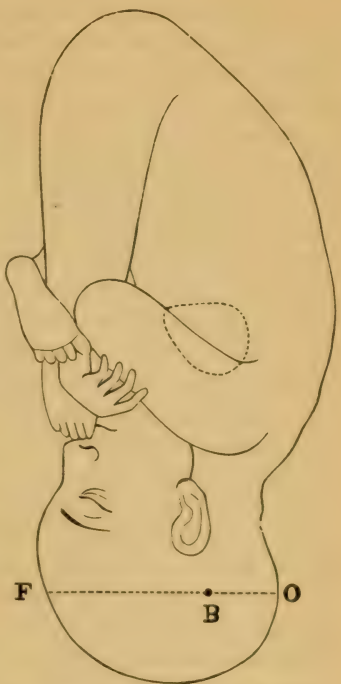


Fig. 55.—Attitude of fœtus *in utero*. (Tarnier et Chantreuil.)

* *Vide* historical part of Cohnstein's paper entitled Die Aetiologie der normalen Kinderlage, Monatssch. f. Geburtsk., Bd. xxxi, p. 142.

† Dubois, Mémoire sur la cause des présentations de la tête, Mém. de l'Acad. Roy. de Méd., tome ii, 1833, p. 265.

‡ Simpson, Attitude and Positions of the Fœtus in Utero, Obstetric Works, edited by Priestley and Storer, vol. ii, p. 81.

motory movements of an adaptive kind, calculated to restore the disturbed presentation. Duncan * and Veit succeeded in partially rehabilitating the gravitation theory by showing that, notwithstanding Dubois's experiments, the center of gravity lies much nearer the cephalic than the pelvic extremity of the child. They found that a fresh fœtus immersed in a saline fluid possessing nearly the same specific gravity as the fœtus, in place of sinking upon its back or side to the bottom of the vessel, assumed an oblique direction in the fluid with the right shoulder looking downward. † They therefore concluded that the fœtus, lying upon the inclined plane furnished by the uterine walls, would naturally assume a similar position were no other forces operative to interfere. Credé, Kristeller,‡ and Braxton Hicks # maintain that the contractions of the pregnant uterus adapt the position of the fœtus to the form of the uterus. Veit believes that the stability of the fœtus is insured by the descent in advanced pregnancy of the presenting part below the level of the pelvic brim.

Now, each one of these conflicting ideas undoubtedly represents a portion of, but not all, the truth. It is certain that the influences cited do exist, and it only remains for us clinically to assign to each its relative value. In the early months of pregnancy, the spheroidal shape of the uterine cavity, the small size of the fœtus in comparison with that of the uterus, and the large proportion of amniotic fluid, all allow the fœtus the greatest measure of mobility. At this time the position of the child must be influenced by the active movements which are felt by the mother subjectively often as early as the fourteenth week. As usually, during the first half of pregnancy even, the shoulder and head are turned downward, it is fair to ascribe this position to the laws of gravity. The frequency of malpresentations in premature labors is explained in part by the tardy dilatation of the cervix and the mobility of the fœtus, which render easy the displacement of the head from its first position, under the influence of pressure exerted upon the axis of the child's body. Malpresentations are more frequent in the case of a dead fœtus than in the living, but Duncan has shown that in the dead fœtus, owing to *post-mortem* changes, the center of gravity often shifts toward the pelvic extremity. With the advance of pregnancy, as the longitudinal exceeds the lateral growth of the uterus, the child adapts itself to the long axis of the uterus, and the further pregnancy advances the more complete the adaptation becomes. When from any cause or condition the correspondence between the fetal and uterine axis is disturbed, compression of a portion of the cutaneous surface of the fœtus results. Reflex movements,

* Duncan, Researches in Obstetrics, p. 14. Veit, Scanzoni's Beiträge, Bd. iv. p. 279.

† On account of the liver upon the right side.

‡ *Vide* Schroeder's Handbuch der Geburtshülfe, 4te Auflage, p. 47.

Hicks, Contractions of Pregnant Uterus, Obstet. Trans., p. 224.

especially in the lower extremities, are excited, which restore the fœtus to that position in which it enjoys the most complete freedom from discomfort. Often, too, the uterine walls resent the pressure of the fœtus, and, by their contractions, serve to maintain the body of the child in the uterine axis.

In cases of hydramnios the conditions more nearly resemble those which exist in early pregnancy; hence malpresentations occur with greater frequency, favored by the mobility of the fœtus in the surplusage of amniotic fluid. *Per contra*, when, as is the case toward the end of normal pregnancies, the fœtus nearly fills the intra-uterine space, the movements are very restricted, and displacements rare.

In primiparous women, the pyriform shape of the uterus in the later months is most marked, and as a consequence the head of the child is usually held by the uterine walls in the pelvic cavity. In multiparæ, on the contrary, owing to the relaxation of the uterine parietes, it is usual for the child, in obedience to the laws of gravity, to lie somewhat obliquely in the uterus, with its head resting upon one of the iliac fossæ. As soon as labor begins, however, the uterine contractions carry the head to the axis of the superior strait of the pelvis.

The changes in the fetal presentation are not, however, confined to simple conversions from an oblique to an upright direction, or to shiftings of position in obedience to laws of gravity. But even in advanced pregnancy a breech-presentation may become a head-presentation, and *vice versa*.* P. Müller reported a case in which the fœtus made six such revolutions within five days.† Now, it can not be supposed that the difficulties which the fœtus must encounter from the resistance of the short transverse diameter of the uterus could be overcome by such comparatively feeble forces as gravity, or reflex adaptive movements, or partial uterine contraction. In Müller's case the changes, if the mother's story be correct, must have taken place not gradually but suddenly, and by the vigorous movements of the child's limbs. Meeh ‡ calls attention to the fact that the movements of the child are produced chiefly by the extension of the lower extremities, and argues that these movements aid to a greater extent in changing the presentation of the child when the breech occupies the lower segment of the uterus, because of the solid resistance offered by the bony pelvic ring, while in head-presentations the pressure of the extremities against the elastic fundus is in the rule unavailing to effect any considerable changes of position.

* Schroeder, Schwang., Geb. u. Wochenbett, Bonn, 1867, p. 21; Schultze, Unters. über den Wechsel der Lage, etc., Leipsic, 1868; Fassbender, Berl. Beiträge zur Geb. und Gynæk., Bd. i, p. 41.

† Scanzoni's Handbuch der Geb., 4te Auflage, p. 123.

‡ Meeh, Warum kommt das Kind am häufigsten in der Kopfendlage zur Welt? Arch. f. Gynæk., vol. xx, p. 185.

By *position* is designated the relation of a determinate point in the body of the fœtus to the uterine walls. In head or breech presentations, the back of the child is most commonly turned to the left, which, hence, is termed the first position. The back turned to the right is known as the second position, and occurs with much less frequency.

In the first position the back is usually directed somewhat anteriorly, while in the second position it is turned rather to the rear. In shoulder-presentations the back is usually directed to the front. Changes of position are frequent in pregnancy, and take place, when other influences do not prevent, in obedience to laws of gravity. When the woman stands erect, the axis of the uterus is continuous with the axis of the superior strait of the pelvis, and forms with the horizon an angle of thirty-five degrees. The uterus does not occupy exactly the median line, but lies more to the right. It is also twisted slightly upon its axis, so that the left lateral portion is directed somewhat to the front. In the upright position, therefore, the anterior wall of the uterus not only forms an inclined plane, but one, too, with a downward drop toward the left side. Now, if these relations be borne in mind, it will be readily seen that the child, resting upon the inclined plane furnished by the anterior wall, with its right shoulder directed downward, must, if left to itself, turn with its back to the left side of the uterus. In the recumbent posture, the axis of the uterus forms with the horizon an angle of thirty degrees, and the downward slope is to the right side. The child, now resting upon the inclined plane furnished by the posterior wall, with its right shoulder directed downward, would naturally turn with its back to the right side of the uterus. These considerations are not purely theoretical, as, when the conditions have been such as to allow the fœtus latitude of movement, the changes indicated in the fetal position followed changes in the attitude of the mother.*

The position of the child has heretofore been determined by that of the child's head when, after the advent of labor, the head has been brought within reach of the examining fingers. Sutugin, however, maintains that, during pregancy, if the patient be examined in the recumbent position, the back is nearly always turned to the rear whether it be situated to the right or the left of the spinal column. Changes of position by posterior rotation he believes are not uncommon.†

* Hönıng, Scanzoni's Beiträge, Bd. vii, p. 99.

† Sutugin, Beiträge zum Mechanismus der Geburt bri Schödellagen. Klinische Vorträge, No. 310.

PHYSIOLOGY OF PREGNANCY.

CHAPTER IV.

CHANGES EFFECTED IN THE MATERNAL ORGANISM BY PREGNANCY.

Changes in the sexual apparatus and neighboring organs.—Changes in the uterus.—Explanation of apparent shortening of cervix.—Changes in the vagina, vulva, abdomen, navel, breasts, nipple.—Functional disturbances of bladder.—Constipation.—Œdema.—Changes effected in the entire organism.

Changes occurring in the Sexual Apparatus and Neighboring Organs.

The pregnant state is signalized by the nutritive energy imparted by the fecundated ovum to the generative organs and to the viscera in their vicinity.

The uterus, from the inception of pregnancy, increases in vascularity. Its mucous membrane becomes soft and thickened. The muscular fibers are increased seven to eleven times in length, and three to five times in width. During the first five months new muscular fibers are developed, especially upon the inner layer of the uterus. The delicate connective-tissue processes between the muscular fibers become more abundant, and toward the termination of pregnancy display distinct fibrillæ. The vessels increase in number, length, and circumference. The arteries, as we have noticed, assume a spiral course, and in places communicate directly with the veins. The veins are dilated, and form, especially in the placental region, wide-meshed networks. The walls of the veins are intimately united with the muscular walls of the uterus, and form, when divided, open-mouthed canals. The lymphatics, starting from the spongy tissues of the lining mucous membrane, traverse the muscular structures, and are gathered up by abundant plexuses, which are distributed especially over the fundus and sides of the womb. The nerves increase in length and thickness, and grow inward toward the uterine cavity. Upon the inner surface of the uterus ganglia may be observed.* The ganglion cervicale, which measures in the non-pregnant condition three fourths of an inch in length and half an inch in width, is now an inch and a half in breadth, and possesses a length of two inches.

* Spiegelberg, Handbuch der Geburtshülfe, p. 50.

These textural changes are accompanied by an enormous increase in the volume of the uterus. The weight of the latter in the virgin state is about an ounce, while toward the end of pregnancy it weighs in the neighborhood of two pounds. The increase in the bulk of the uterus is progressive. The following table, by Arthur Farre,* furnishes approximate measurements for the different months of pregnancy:

	Length.	Width.
End of 3d month	4½–5 inches,	4 inches.
" 4th "	5½–6 "	5 "
" 5th "	6 –7 "	5½ "
" 6th "	8 –9 "	6½ "
" 7th "	10 "	7½ "
" 8th "	11 "	8 "
" 9th "	12 "	9 "

According to Levret, the surface of the virgin uterus msasures sixteen square inches, while that of the pregnant uterus at term measures three hundred and thirty-nine square inches.† The uterine cavity is stated by Krause to be enlarged five hundred and nineteen times.‡

The enlargement of the uterus is not due, in the beginning of pregnancy at least, to the pressure of the expanding ovum, for the same changes occur during the first four months in cases of extra-uterine pregnancy. In the latter months, however, a mechanical stretching is probable, as the walls become thinned and conform to the size of the ovum. At term, the walls are not of uniform thickness, but vary between one sixth and one fourth of an inch.

In pregnancy the muscular fibers of the uterus, as has been shown by Ruge, Hofmeier, and others, are arranged in groups, which possess a lamellar structure, the individual layers pursuing a general direction from the peritoneal covering downward and inward toward the lining mucous membrane. The principal layers are in turn united by communicating bundles, so that when separated from one another the spaces between them have a rhomboidal shape. Very nearly the same appearances are obtained when the section is transverse or oblique as when made in a longitudinal direction. Over the larger portion of the uterine surface the peritonæum is firmly adherent. Only at the lower segment, for a space varying from three to six centimetres, measured from the internal os, the peritoneal attachment is easily separable. According to Hofmeier,# the muscular plates in this division are loosely associated together, and the fibers of each lamella are intimately interwoven, crossing one another in every direction. In

* Cyclopædia of Anatomy and Physiology, article Uterus and its Appendages, p. 645.

† *Vide* Scanzoni, Handbuch der Geburtshülfe, p. 77.

‡ *Vide* Spiegelberg, Handbuch der Geburtshülfe, p. 51.

Hofmeier, Das Unterer Uterensegment in Schroeder's Schwagnere und Kreissende Uterus, p. 59.

the body proper of the uterus there is a broad muscular layer, which adheres firmly to the peritoneal covering, the differentiation of the individual lamellæ is more pronounced, the muscular fibers are arranged more in bundles, and, in general, form layers which correspond to a greater degree to the longitudinal and transverse axes of the uterus.

The uterine artery, after first supplying a branch to the cervix, runs up along the side of the uterus, and gives off the first important branch to the body of the uterus at the point where the peritonæum firmly adheres to the muscular walls. The lower segment, therefore, receives no important vessels, and is characterized by a low degree of vascularity.*

With the growth of the gravid uterus, the peritoneal coat is put upon the stretch, and, in places, a thickening of the serous membrane takes place by the formation of new tissue elements. At the same time the folds of the broad ligaments gradually separate, so that toward the end of pregnancy the ovaries and Fallopian tubes are in close contact with the uterus.

The growth of the uterus is confined chiefly to the body, the cervix participating only to a slight extent. In the early months, the increase is rather in the antero-posterior and lateral diameters than in the longitudinal diameter. As a consequence, in the rule, it is not until the fourth month that the fundus can be felt through the abdominal walls above the symphysis pubis. In these earlier months the normal anteflexion of the uterus is increased by the weight of the cor-

FIG. 56.—Lower segment of uterus, sixth month pregnancy. (Hofmeier.) *B*, boundary of firm peritoneal attachment; *O. i.*, internal orifice; *O. e.*, external orifice.

* HOFMEIER, Beiträge zur Anatomie der Schwangeren und Kreissenden Uterus, p. 33.

pus uteri. In the fifth month the uterus fills the hypogastrium, and in the ninth month reaches the epigastrium. During the last two weeks, however, the uterus sinks somewhat into the pelvic cavity. At the same time the fundus of the uterus sinks downward and forward, so as to stand about three inches beneath the lower extremity of the sternum.

In the upright posture the uterus, in advanced pregnancy, rests upon the anterior abdominal walls. As, in the intervals of contraction, the uterus is a mere sac with fluid contents, it becomes flattened from front to rear, and the width increases at the expense of the distance from the fundus to the symphysis pubis. In the horizontal position, in which the uterus rests upon the vertebral column, its length is, on the contrary, increased and its width diminished. In the upright position, the intestines occupy the space posterior to the uterus. In the dorsal position, the intestines lie chiefly upon the sides, but partly, too, in front of the uterus.

During the first three months of pregnancy the pyriform shape of the uterus is preserved. During the succeeding three months, owing to the relative increase in the lateral and antero-posterior diameters, the body gradually assumes the appearance of a flattened spheroid. After the sixth month the longitudinal diameter again preponderates.

As the dilatation of the uterus takes place more rapidly in its upper than in its lower segment, the cavity of the organ assumes, under normal conditions, an oval shape, with the narrow end pointing downward, corresponding to the ovoid shape of the fœtus in head-presentations. It was long taught and believed that this change of shape, occurring in the later months of pregnancy, was due to the gradual unfolding of the cervix uteri from above downward, which thus contributed to the enlargement of the uterine cavity. It is, however, probable that, with rare exceptions, the cervix uteri maintains its complete integrity up to the commencement of labor. The enlargement of the uterus, necessitated by the development of the fœtus, results chiefly from the growth and distention of the fundus and posterior uterine wall.

The cervix uteri participates in the hypertrophy of the entire uterus. Its development, however, is completed by the fourth month, and is the result not so much of increased growth or new formation of tissue elements as of the loosening of its structure and swelling from serous infiltration. This latter is the consequence of a hyperæmia of the cervix, which results from the passive relaxation and dilatation of the cervical vessels. It occasions a physiological softening of the tissues, which first manifests itself in those portions of the cervix where the least resistance is encountered, viz., beneath the mucous membrane beginning at the os externum, extending outward through the muscular structures of the vaginal portion, and afterward upward

toward the os internum.* The follicles of the cervical mucous membrane furnish a thickened secretion, which fills the cervical canal, and forms what is known as the "mucous plug." Frequently the orifices of the follicles become occluded. The follicular sacs then fill with their own secretion, and project from the mucous surface as the ovules of Naboth. Erosions about the os externum are rarely absent in advanced pregnancy.

With the advance of pregnancy an apparent shortening of the cervix takes place, at first confined to the vaginal portion, but afterward involving the entire organ. The earlier explanation of this phenomenon, and one which still meets with very general acceptance, assumes that, after the sixth month, a gradual unfolding of the cervix from above downward takes place, which contributes to the enlargement of the uterine cavity. In this manner space is provided in correspondence with the rapidly increasing growth of the fœtus. The strength of this doctrine lay, in a great measure, in the seemingly confirmatory evidence afforded by digital explorations.

In opposition to the current opinion, Stoltz, in his inaugural thesis, published in 1826,† maintained that the internal os remained closed up to the last two weeks preceding delivery, when, indeed, under the influence of painless contractions, the effacement of the cervix, described by earlier writers, did in fact, at least in primiparæ, take place. Stoltz explained the apparent shortening of the cervix as the result of a spindle-shaped dilatation of the cervical canal, causing an approximation of the external and internal orifices. In 1859 Duncan‡ furnished corroborative evidence of the general correctness of Stoltz's view, by means of two dissections of uteri derived from women who died respectively in the seventh and eighth months of pregnancy. In these cases the length of the cervix uteri had undergone little or no change consequent upon pregnancy. Duncan, however, in common with Stoltz, admitted that, during the later days of gestation, incipient uterine contractions of a painless nature may lead to the opening of the internal os. In 1863 he showed that Stoltz's discovery had been anticipated by Weitbrecht in 1750.# In 1862 Professor I. E. Taylor,‖ of New York, stated, what is without doubt true in the majority of cases, that the cervix remained closed, and retained its entire length up to the very beginning of active labor. In evidence he offered the results of four *post-mortem* examinations made upon women dying from

* Lott, Zur Anatomie und Physiologie des Cervix Uteri, Erlangen, 1872, pp. 35, 36.

† Sur les différents états du col de l'utérus, mais principalement sur les changements que la gestation et l'accouchement lui font éprouver, Strasbourg, 1826.

‡ On the Cervix Uteri in Pregnancy, Edinburgh Med. Jour., vol. iv, 1859, p. 774.

Vide Edinburgh Med. Jour., September, 1863.

‖ Taylor, On the Cervix Uteri, Am. Med. Times, June 21, 1862.

accidental causes during the first stage of labor.* In 1873 I found in the dissecting-room a woman seven months pregnant, who had died in the first stage of labor, but after dilatation of the cervix had well advanced. The bag of waters, in the form of a cylindrical sac two inches in diameter, protruded into the vagina. Both the cervical orifices were distinctly defined; the cervix was equally expanded throughout its entire extent; and the head rested above the os internum. The cervix clearly formed no part of the uterine cavity, but served merely as a communicating passage between the uterus and vagina. Dr. Taylor has made some very interesting observations upon the action of the cervix during labor, using for the purpose a large (three to three and a half inch) cylindrical speculum, by means of which the entire process can be freely witnessed. In multiparous women he has seen the head descend during a pain so as to produce complete obliteration of the cervix, and then recede, leaving the latter with the same appearances as existed previous to labor.†

While the non-shortening of the cervix has been fairly demonstrated, it is not so clear that the os internum remains closed in all cases up to the beginning of labor. Certainly there are rare exceptions to the rule. Litzmann‡ reported a case in which the membranes were found, at the time of labor, attached to the cervical wall around the periphery of the os externum. In a few instances I have had an opportunity, during the last period of pregnancy, to determine by touch the dilatation of the os internum. The cervix, however, did not expand in such a way as to become continuous with the uterine cavity, but remained distinct and apart, preserving its independent existence. How far such a dilatation is due to painless labor it is impossible to say. Müller# regards it rather as the result of the pressure of the head upon the softened cervix. I had once occasion to examine a multipara toward the end of gestation, to determine the question as to the safety of her making a railroad journey to a neighboring city. I found the head low, the cervix soft, and the os internum clearly dilated to the size of a dollar. Two weeks later I was called to see her in the early stage of labor, and found that, under the influence of the uterine contractions, the canal of the cervix had again closed.

The apparent shortening of the cervix is unquestionably due in part to the swelling, incident to pregnancy, of the vaginal mucous

* *Vide* likewise the case of Angus McDonald, in Edinburgh Med. Jour., April, 1877.

† Med. Record, October 13, 1877.

‡ Das Verhalten des Cervix Uteri in der Schwangerschaft, Arch. f. Gynaek., Bd. x, p. 130.

Untersuchungen über die Verkürzung der Vaginalportion in den letzten Monaten der Gravidität: Scanzoni's Beiträge, Bd. v, H. 2, 1869, pp. 306 *et seq.* Müller does not, however, exclude the possible action of uterine contractions.

membrane, and of the vascular, loose-meshed tissues surrounding the cervix at the vaginal junction. But, in addition, a noticeable difference may be observed between cases in which the head occupies the pelvis and those in which it rests upon an iliac fossa. In the latter the cervix is found, both by the speculum and by the touch, to have preserved its entire length. In the former, on the contrary, the anterior lip is often obliterated, while the length of the canal and the posterior cervical wall remain unchanged.

In explanation of this phenomenon, it is to be borne in mind that in the upright position the uterus forms with the horizon an angle of thirty-five degrees. The weight of the ovum, resting upon the inclined plane of the uterus, increases the convexity of the anterior wall, and the head of the fœtus, when it enters the pelvic cavity, does not fall directly upon the os internum, but somewhat in front, producing,

FIG. 57.—*B*, borders of the cervical mucous membrane; *Pl.* placenta; *V.* bladder; *O.i.*, os internum; *O.e.*, os externum; *A a'*, apparent length of cervical canal on digital examination

in accordance with the laws of gravity, a bulging of the anterior lower segment. Upon vaginal examination the head is felt, therefore, low down, and covered by the uterine walls, while the cervix is drawn upward and backward by the retractor muscles, and is often reached with difficulty, because the finger, in passing to it, has first to make the circuit of the child's head. The bulging produced by the latter effaces the angle between the anterior lip and the vaginal wall, while the posterior lip remains unchanged. The canal of the cervix assumes

an oblique or nearly vertical direction, but when examined with care, with due regard to the physiological softening of its tissues, is found to have preserved its normal length. By pushing the head away from the cervix, or by placing the patient in the knee-elbow position, so as to allow the head to recede, the anterior lip resumes its normal dimensions.*

Bandl (Ueber das Verhalten des Uterus und Cervix in der Schwangerschaft und während der Geburt, 1876) has sought to prove that whereas, in point of fact, a portion of the cervix remains closed to the end of pregnancy, a portion of the same does, as Roederer taught, contribute to the formation of the uterine cavity.

In presenting his views to the Naturforscher-Versammlung at Hamburg, in 1876, Bandl stated that, upon examination of the familiar Braune section, made upon the cadaver of a parturient woman, he was struck with the impossibility that the cervix therein depicted, measuring eleven centimetres in front and ten centimetres posteriorly, could be the short narrow canal, from two to four centimetres long, observed by Müller toward the end of gestation. As a rule, however, in case of the deep position of the ovum, or fetal head, above the constriction designated by Müller as the os internum, may be felt a second and much larger ring, which his subsequent investigations showed was the os internum proper. The lower constriction he termed, therefore, the spurious os internum, or the ring of Müller. Owing to the fact that the walls of the canal between the upper and lower rings are much thinner than those of the uterine body, a well-defined ridge is felt, which has since been termed the ring of Bandl.

At first Bandl supposed that the new cervico-uterine canal was covered by decidua, the mucous membrane proper having been crowded downward by the pressure of the ovum. In this way, by the formation of overlapping folds, the ring of Müller is approximated to the os externum, and the apparent shortening of the cervix is accomplished. At the same time, by the continued growth, and by what he termed the vital action of the parts, a "new cervix" was formed above the remains of the old canal, derived chiefly by a sort of migratory movement from the muscular structure of the original cervix. The decidua, meantime, unable to follow the expansion of the outer layers, was torn in many places, forming scattered islets, between which the chorion came into immediate contact with the muscular walls.

In September, 1877, at a meeting of the German gynæcologists at Munich, Bandl abandoned his theory of a new cervix formed by a movement upward of muscular fibers and the crowding down of the cervical mucous membrane, and taught in its place that, in primiparæ, a portion of the cervix really expands to contribute to the uterine cavity. In the earlier months, he stated, the mucous membrane of this portion retains its cervical characteristics, but in the latter part of gestation it is converted into a kind of decidua. The flattened, expanded portion in multiparæ, he acknowledged, was often extremely small.

* P. Müller, *op. cit.*, p. 342.

Lott, Verhalten des Cervix Uteri während der Schwangerschaft, p. 71.

I. E. Taylor, Non-shortening of the Cervix during Gestation, Med. Record, October 13, 1877, p. 646, with verbal statement of the author concerning the results of his examinations of pregnant women in the genu-pectoral position.

This, at first, he attributed to morbid conditions, such as slight inflammations, or defective involution, which interfered with the rolling out of the upper portion of the canal. In 1879, before the Natur.-Versammlung at Baden-Baden, he explains finally that, in first labors, the mucous membrane of the dilated portion of the cervix becomes torn and stripped off. Subsequently a new membrane is formed upon the denuded surface which is not distinguishable from that of the uterine body, and upon which, in future pregnancies, the decidual formation may be traced to the persistent portion of the canal. The os internum, according to this view, is not marked by the cervical mucous membrane, but is situated in the muscular walls, and usually corresponds to the point at which the peritonæum leaves the uterus.

Küstner (Beiträge zur Anatomie der Cervix Uteri, Arch. f. Gynaek., vol. xii, p. 383) and Marchand (Noch Einmal das Verhalten der Cervix Uteri in der Schwangerschaft, Arch. f. Gynaek., vol. xv, p. 169) claimed in certain cases to have found the plicæ palmatæ and cylindrical epithelial cells at the distance of from two to two and a half centimetres from the internal os, showing that a funnel-shaped expansion of the upper portion of the cervix does take place during pregnancy. Further evidence in support of Küstner's views has been offered by Keilmann (Zur Klärung der Cervixfrage, Zeitschr. f. Geburtshülfe und Gynaek., vol. xxii, p. 106) derived from observations made upon the uteri of gravid bats.

Bayer (Gynaekologische Klinik, von Freund, Art. Morphologie der Gebärmutter, 1885), in an extremely complicated account of the muscular structure of the uterus, maintains, likewise, that the lower segment is produced by the rolling out of the upper part of the cervix, and that the cervical mucous membrane is converted into decidua. He regards the process as a temporary provision, which disappears with pregnancy. The constriction termed by Bandl the ring of Müller, Bayer maintains, is not an accidental point in the cervix, but is the result of the loop-like arrangement of fibers derived from the retractor muscles, by which the continuance of the cervical eversion is arrested at a definite point in the canal.

According to investigations made by Leopold, McDonald, Müller, Sänger, Schroeder, Hofmeier, Waldeyer, myself, and others, the lower segment is derived from the body of the uterus, and not from the cervix. In three autopsies made by me upon women who had died in the last month of pregnancy—one primipara and two multiparæ—the same conditions prevailed in all, viz., the cervix exceeded four centimetres in length and was increased in thickness, the mucous plug terminated at the upper orifice, and the membranes adhered closely to the lower segment and to the borders of the internal orifice. That the cervix maintains its independence to the beginning of labor is therefore true in very many instances. That there are no exceptions, it would be hazardous to maintain in the face of the positive testimony of Bandl, Marchand, and Bayer.

In the vagina changes take place corresponding to those in the uterus, though, of course, less in degree. The smooth muscular fibers hypertrophy; the vessels of the venous plexus increase in size, and impart a blue color to the vaginal walls; the mucous membrane becomes

thickened, and furnishes a more abundant secretion. The mucous membrane likewise increases in length, so that, in spite of the fact that it is lifted upward by the elevation of the uterus, the anterior vaginal

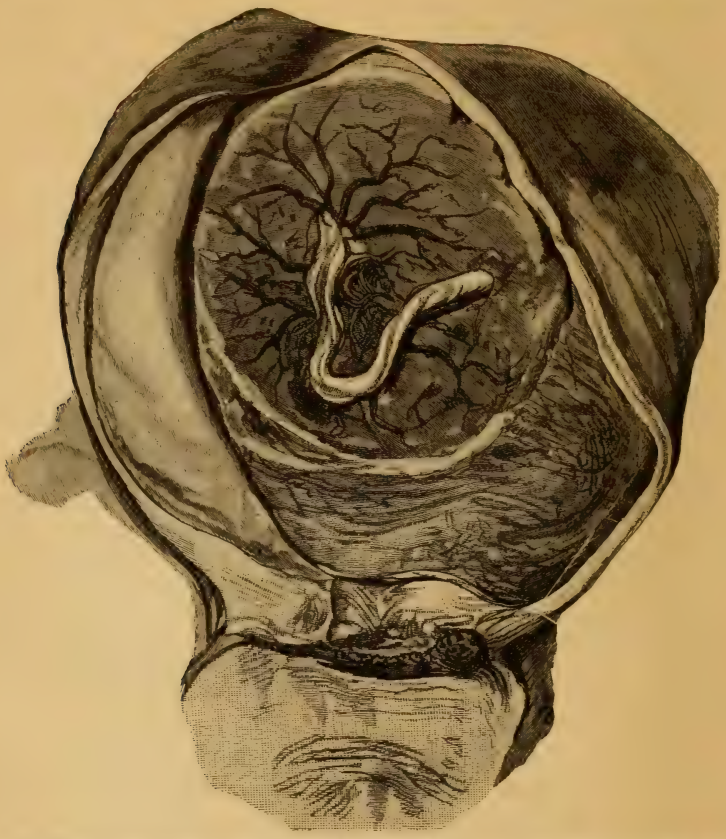


FIG. 58.—Uterus from a multipara who died in the last month of pregnancy, showing cervix of normal length with membranes adherent to the os internum. (Bellevue Hospital.)

wall not unfrequently protrudes from the vulva. The papillæ swell, and impart a granular feel to the finger.

The vulva becomes turgescent, the labia gape apart, to the mucous surface the enlargement of the veins and venous plexuses gives a dusky hue, and the follicles secrete abundantly.

The connective tissue between the layers of the broad ligaments and around the uterus becomes succulent from serous infiltration. The lymphatics, which convey away the waste engendered by the rapid tissue-changes in the pelvic organs, enlarge in conformity with the increased labor thrown upon them. The hips broaden from the deposit of fat in the subcutaneous tissue of the entire pelvic region.

With the growth of the uterus the abdominal walls are put upon

the stretch, and, in well-nourished individuals, are increased in thickness by the more abundant formation of adipose tissue. By the fifth month the navel begins to diminish in depth, and about the seventh month becomes level with the skin. During the last two months the navel often is everted by the pressure of the uterine tumor, and forms a rounded elevation. Another consequence of the stretching of the abdominal walls is the formation of reddish, bluish, and at times of white glistening streaks (striæ), which do not disappear after delivery, though they lose their coloring. They rarely fail in the last third of pregnancy. They are found most abundant upon the lower half of the abdomen, especially upon the sides, where they form curved, sinuous lines. They are due to an atrophic condition of all the skin-layers, to partial obliteration of the lymph-spaces, and to a condensation of the connective-tissue elements, which, in place of forming rhomboid meshes, run parallel to one another.* Striæ are produced likewise in pathological distentions of the abdomen, and are not peculiar to pregnancy. Similar streaks form upon the nates and upon the anterior and posterior surfaces of the thighs. They may occur, too, independent of pregnancy, as in the rapid development of the hips at puberty. Painful sensations at the costal insertions of the abdominal muscles are often experienced during pregnancy. They occur more commonly in multiparæ, and, owing to the preponderance of the right lateral position of the uterus, with greater frequency upon the right side. Sometimes the recti muscles are separated from one another. This is specially liable to take place in contracted pelves, and in women of small stature, in whom, on account of the insufficient longitudinal diameter of the abdominal cavity, the uterus is forced to make for itself the space requisite for its development to term at the expense of the abdominal walls.

The mammary glands, previous to gestation, are firm and nearly hemispherical. During pregnancy the breasts increase in volume, and present characteristic changes in structure and consistence. These changes are due to a swelling of the connective tissue of the organ, the development of glandular acini along the course of the lactiferous ducts, and the increased deposition of fat between the lobes. The enlargement of the breast often begins in the second month, and becomes noticeable between the fourth and fifth months of gestation. With the development of the glandular structure the breasts possess a knotty, uneven feel, more marked at first about the periphery of the organ, and thence proceeding gradually toward the nipple. The veins enlarge, and form a tracery beneath the skin. Early in pregnancy, fullness of the breasts, and pains, shooting toward the axilla, are often experienced. As the breasts increase in size, the cutis yields in many women about

* Busey, The Cicatrices of Pregnancy, Trans. of the Am. Gynæc. Soc., vol. iv, p. 141.

the periphery, where the tension is greatest, whereby bluish, white, or reddish lines, like those remarked upon the abdomen and thighs, make their appearance.

The nipple becomes elongated, is more sensitive, and enters readily into an erectile condition. Changes in the areola are justly regarded as among the most important evidences of the existence of pregnancy. Often as early as the second month the areola has a soft, œdematous feel, and is raised above the level of the surrounding skin. The sebaceous follicles, ten to twenty in number, enlarge, and bedew the surface with moisture. By the middle of pregnancy a circle, due to pigmentary deposit, is formed around the nipple, the coloration of which depends in part, though not altogether, upon the complexion of the individual, being usually more intense in brunettes than in women with fair hair and delicate skins. In the negress the areola is jet-black, while in the albino it is of a delicate rose-color (Montgomery). The diameter of the pigmented circle averages from an inch to an inch and a half, though it sometimes greatly exceeds the figures mentioned. In the latter part of pregnancy there often forms around the outer part of the areola a so-called secondary areola, consisting of scattered round spots, presenting the appearance as though, to use the language of Montgomery, the color had been discharged by a shower of drops. This peculiarity is due, for the most part, to the presence of enlarged, non-pigmented sebaceous follicles.

The pressure of the gravid uterus gives rise to functional disturbances in the neighboring organs of the pelvic cavity. The capacity of the bladder is diminished, and, as a consequence, increased frequency of urination results. In some women, when the bladder is moderately full, the mere act of coughing or sneezing, or the upright posture, produces involuntary discharges of water. Constipation is common, due not so much, however, to mechanical obstruction as to diminished intestinal action. In the later months of pregnancy, pressure on the sacral nerves gives rise at times to numbness of the extremities, neuralgic pains, cramps, and hindered locomotion. Œdema of the lower half of the body and varicose dilatation of the veins of the legs, the rectum, and vulva, are referable partly to pressure and partly to the increased vascular fullness of the pelvic vessels induced by pregnancy.

Changes effected in the Entire Organism.

Corresponding to the enormous development of the vascular apparatus in the gravid uterus, there is an increase in the total quantity of blood in the circulation.* Andral and Gavarret, Regnault and

* This assertion, which is simply the formal statement of a physiological necessity, has been experimentally proved to be correct in bitches by Spiegelberg and

Becquerel and Rodier, maintained that in pregnancy the blood was serous in character. This view was sustained apparently by the later investigations of Nasse, Spiegelberg, Gscheidlin, Ingerslev, and Meyer. It is unquestionable that in early pregnancy a hydræmic condition develops in many women, consequent upon the demands made upon the maternal system by the growing fœtus, and upon the increased tissue waste when these conditions are associated with a diminished capacity to take and assimilate food; but with improved methods of examination it has been demonstrated by Fehling, Rein, and Richard Schroeder that, in advanced pregnancy, both the hæmoglobin and the total number of red blood-corpuscles, are in the rule, augmented.*

As a necessary corollary to the increase of the total blood-supply in pregnant women, the maintenance of the circulation would seem to require either greater frequency in the contractions of the heart, or that the entire quantity of blood entering the ventricles during the diastole should be increased. Kehrer maintains that the frequency of the pulsations of the heart exceeds eighty to the minute. Larcher† and other French investigators assert that the interposition of the enlarged and multiplied vascular channels in the pelvic organs increases the labor thrown upon the heart, in response to which an eccentric hypertrophy of the left ventricle takes place, but the evidence on this point is conflicting.

Pregnancy increases the size of the thyroid gland. In districts where goître is endemic, and in women in whom a predisposition already exists, pregnancy may produce a temporary form of the disease, or furnish the starting-point of the permanent affection.‡

In rather more than half the cases of pregnancy, thin bone-like lamellæ, consisting chiefly of phosphate and carbonate of lime, measuring from one sixth to one half a line in thickness, are found deposited upon the inner surface of the skull. These plates have been termed osteophytes by Rokitansky. They occur after the third month, and are found chiefly upon the frontal and parietal bones, especially along the course of the sulcus falciformis and the *arteria meningea media.*#

We have already noticed the increase in the carbonic acid discharged

Gscheidlin. *Vide* Untersuchungen über die Blutmenge trächtiger Hünde, Arch. f. Gynaek., Bd. iv, p. 112.

* *Vide* Schroeder, Untersuchungen ueber die Beschaffenheit des Blutes von Schwangeren und Wöchnerinnen, etc., Arch. f. Gynaek., vol. xxxix, p. 306.

† *Vide* Joulin, Traité complet d'accouchement, p. 383.

‡ L. Tait, Enlargement of the Thyroid Body, Obstet. Jour. of Gr. Brit. and Ire., June, 1875.

Förster, Handbuch der patholog. Anat., Bd. ii, p. 945. These osteophytes are not peculiar to pregnancy; they likewise occur commonly in consumptives. Nouveau Dict. de Chir. et de Méd., t. xvii, Art. Grossesse.

by the lungs during pregnancy. Andral and Gavarret found the mean consumption of carbon hourly in pregnant women equaled 8 grammes instead of 6·4 grammes, as in menstruating women. The thorax is increased in breadth and diminished in depth, a condition which becomes reversed after delivery. There is usually, toward the end at least, a diminution in the vital capacity of the lungs.* Subjectively, there is often experienced, especially in primiparæ, a sense of oppressed respiration during the later months of pregnancy. This feeling is relieved, however, to a considerable extent when the uterus, in the last two to three weeks of pregnancy, sinks downward and forward.

Very few pregnant women escape altogether troubles of digestion; of these the most common are nausea and vomiting, due to spasmodic contractions of the stomach and diaphragm. The nausea and vomiting usually occur on waking in the morning, i. e., with an empty stomach, more rarely after meals. In a few cases, these gastric disturbances take place only three or four times in the beginning of pregnancy, upon the first suppression of the menses. Usually, however, they recur daily during the first three months, and then gradually disappear. In the early period of pregnancy, the appetite is, as a rule, capricious, like that of chlorotic women. Some are said to crave unusual and even disgusting articles of food (longings). An increased secretion of the salivary glands is often a noticeable symptom. The bowels are more commonly constipated. In a few, however, diarrhœa takes place, often about the time of the month when the woman would, if not pregnant, have her menstrual flow.

It is not surprising that in the first three months of pregnancy many women lose their flesh and color, have dark circles about their eyes, and wear a drawn, haggard look; but after the third month, or later, after fetal movements have been felt, the appetite returns, the digestion becomes more active, the nutrition is improved, and an increase of weight in normal cases takes place, which can not be accounted for simply by the growth of the ovum. According to Gassner's estimates, the average gain in the eight months amounts to five and a half pounds, in the ninth month to three and a half pounds, and in the tenth month to about three and a quarter pounds. The total increase he found not far from one thirteenth of the entire weight of the body.†

We have already noticed the pigmentation of the areola in speaking of the changes produced in the breasts of pregnancy. The forehead

* Dohrn found that in sixty per cent there was a marked diminution in the vital capacity of the lungs of women in the latter part of pregnancy, as compared with that of the same women tested twelve to fourteen days after delivery. Zur Kenntniss des Einflusses von Schwangerschaft und Wochenbett auf die vitale Capacität der Lungen, Monatsschr. f. Geburtsk., Bd. xxviii, 1866, p. 457. Earlier observations, not entirely in accord with those of Dohrn, were made by Fabius and Wintrich. *Vide* SPIEGELBERG, Lehrbuch der Geburtshülfe, 1877, p. 63.

† Monatsschr. f. Geburtsk., Bd. xix, p. 1.

likewise at times becomes covered with dirty-looking brownish patches, which may extend over the entire face, especially over the eyelids, the root of the nose, and the upper lip. These spots, with the disfigurement they occasion, rarely remain permanent, but, as a rule, disappear shortly after confinement. Similar discolorations are often observed about the external organs of generation, upon the abdomen, and, with considerable constancy, along the linea alba and around the umbilicus.

Owing to the hydræmic condition which exists during pregnancy, the urine is more abundant and watery. Albumen in the urine is not an infrequent occurrence, due, probably, in the milder cases, to transitory catarrhal affections of the bladder.*

The nervous system becomes more impressionable. The whole character frequently undergoes a change. The most amiable of women are liable to become fretful, peevish, and unreasonable. The spirits are often depressed, especially in the earlier months, when the general nutrition is most impaired. The melancholia in women already predisposed to insanity may terminate in mania. The memory is generally weakened, especially in women who have borne a number of children in rapid succession. On the other hand, nervous women sometimes lose their nervousness, and, exceptionally, there are individuals who experience during pregnancy a peculiar sense of well-being. Neuralgic affections are common (face-ache, toothache, etc.); local anæsthesia and paresis occur at times; the senses are often disordered (nyctalopia, amaurosis, amblyopia, deafness, perversions of taste and smell); pruritus is sometimes troublesome; and, finally, pregnant women are subject to attacks of dizziness and syncope.

CHAPTER V.

THE DIAGNOSIS OF PREGNANCY.

Signs of pregnancy.—Suppression of menses.—Nausea.—Salivation.—Breasts.—Increase of abdomen.—Changes of the os and cervix.—Quickening.—Ballottement.—Fetal heart-beat.—Uterine bruit.—Funic souffle.—Interrogation of the patient.—Methods of physical examination.—Inspection of abdomen.—Palpation.—Auscultation.—The vaginal touch.—Distinction between first and subsequent pregnancies.—Diagnosis of death of fœtus.—Duration of pregnancy.—Prediction of day of confinement from date of last menstruation.—Date of quickening.—Size of uterus.

A THOROUGH familiarity with all the signs which lead us to the recognition of pregnancy is an essential part of the outfit of every

* KALTENBACH, Ueber Albuminurie und Erkrankungen der Harnorgane in der Fortpflanzungsperiode, Arch. f. Gynæk., Bd. iii, p. 1.

practicing physician. The reasons for this are obvious. Mistakes as to the diagnosis of the pregnant state can never be covered up. They therefore inevitably subject the author of them to criticism and ridicule. But, apart from personal considerations, it is to be remembered that, in the practice of both medicine and surgery, the coexistence of pregnancy not infrequently modifies materially the prognosis and treatment. Moreover, it is one of the most grateful functions the physician is called upon to perform to be able to dissipate unjust suspicions of pregnancy, which sometimes cloud the reputations of perfectly pure women. On the other hand, the writer has known many cases of grievous wrong and injustice done to the innocent by a careless, hasty, and incorrect decision on the part of the medical examiner. The so-called "signs of pregnancy" are based upon the physiological changes which take place in the ovum, and the changes wrought by the growth of the ovum upon the maternal organism. Many of the signs, therefore, possess little weight, and serve only to draw attention to the possible existence of pregnancy. A number of the signs taken together furnish cumulative evidence of the probability of pregnancy. There are, however, single signs, which, taken individually, make pregnancy probable; only a few possess a positive significance. Hence the rule that the physician keep ever in mind possible sources of error, and, in cases of doubt, that he maintain a prudent reserve in the expression of his opinion.

The diagnosis of pregnancy depends upon an acquired facility in the mental grouping of symptoms in the order of their respective weight, and upon a familiarity with all the methods by which objective symptoms can be determined.

We have, therefore, to consider:

1. The signs of pregnancy, with their limitations and possible sources of error.
2. Methods of physical exploration.
3. The differential diagnosis of pregnancy.

The Signs of Pregnancy.

The *suppression of the menses* is, to most women who have been exposed to impregnation, the first warning of the occurrence of conception. Certainly, where they have been previously habitually regular, this sign rarely leads them into error. Still, it is by no means reliable. To estimate it at its true value, it is necessary to bear in mind the numerous aberrations to which the menstrual function is subject. In married women a retardation of the menses for a few days, or even two or three weeks, is not an uncommon occurrence. These retardations are not unusual in newly-married women, in whom the disturbance appears to follow the novelty of the matrimonial rela-

tion. Again, they may be the result of colds, fatigue, and mental emotions. In the unmarried, who, by reason of imprudent conduct, have had occasion to fear pregnancy, a retardation sometimes occurs as the result of pure apprehension.

The causes of amenorrhœa do not need to be specified here. They are operative in the married as well as in the unmarried. The family physician, however, cognizant of the peculiarities and temperaments of his patients, will easily recognize such conditions, and separate them from the cessation of the menses induced by pregnancy. Should any doubt exist, of course it would be proper to suspend judgment, and await the advent of other symptoms before expressing an opinion.

Pregnancy, while it suspends ovulation, the usual concomitant of menstruation, is not incompatible with a periodic flow, which may obscure the diagnosis. When conception occurs immediately prior to a menstrual period, it frequently does not arrest the discharge, though it usually diminishes the amount. A few women have periodic discharges during the first two or three months of pregnancy, and, in very rare cases, throughout its entire duration. Authors have likewise recorded instances of women whose habit it was to menstruate (?) only during pregnancy (Montgomery). In all such cases it is probable that the hæmorrhage is of cervical origin, and is a pathological phenomenon. In one instance my friend Dr. L. M. Yale, of this city, verified the presence in the cervical canal of a small mucous polypus, with the removal of which the trouble disappeared. In mentioning these deviations from the standard, it is necessary to invite the student to view them in proper perspective. They are of extremely rare occurrence, and the physician will not often fall into error who maintains a skeptical attitude toward cases of supposed pregnancy in which apparently normal menstruation is reported to continue.

In women who are habitually irregular, or in whom the menstrual periods are absent altogether, the question of the existence of pregnancy is often in the early months a very puzzling one. There are now and then patients who menstruate only at long intervals. If they once suspect pregnancy, they are apt to simulate other corroborative signs; or, on the other hand, they may proceed far in gestation without the slightest misgivings of their true condition. In such instances the physician, unless he bases his opinion on purely objective symptoms, is at times drawn into error, which places both himself and his patient in a ludicrous position.

In the same category are to be placed cases of pregnancy occurring in nursing women before the return of the menses, in young girls before the appearance of menstruation, and in women who have apparently passed the climacteric.

Among the *sympathetic* disturbances, those of the stomach possess the greatest diagnostic importance. *Nausea* and *vomiting*, occurring

especially in the morning, and following suppression of the menses, are signs to which the women themselves, and the laity in general, attach great value. They are, however, sometimes absent in pregnancy, while they are present in a variety of other conditions. They are notable features of chlorosis, where they are likewise often associated with suspension of menstruation. However, after eliminating other morbid causes, they are always suspicious symptoms in women who, in their sexual relations, have exposed themselves to conception, and who never experienced similar sensations in the unimpregnated state. Abundant *salivation* possesses a similar significance.*

Tingling sensations and swelling of the *breasts*, turgescence and pigmentation of the areola, the development of the glandular follicles around the nipple, enlargement of the superficial veins, and the secretion of milk, are valuable though not infallible signs of pregnancy. Thus, painful sensations and sympathetic swelling of the breasts may depend upon pathological conditions of the sexual organs. To be of importance, they should be persistent and progressive. The coloration may be the relic of a previous pregnancy. The other changes in the areola rarely lead us into error when they are present, but I have often noted their entire absence. I have likewise noted cases where there was entire absence of milk in the breasts until after confinement. Numerous and very curious instances of milk in the breasts of the non-pregnant have been recorded. The importance of these exceptions is greatly lessened by the fact that milk rarely appears in pregnancy before the development of other signs which enable us to make the diagnosis certain.

Increase in the size of the abdomen during the child-bearing period always suggests the existence of pregnancy. But it is to be remembered that it is not invariably of uterine origin. Thus, it may result from ascites, from an excessive deposit of adipose tissue in the abdominal walls, from tympanitic distention, and from various abdominal tumors having no connection with the uterus. If the enlargement proves to be due to a uterine tumor, we have then to exclude fibroids in the earlier months, subinvolution, and the increase of size often associated with peri-uterine inflammations. The absence of uterine enlargement in women supposed to be several months pregnant, possesses, of course, absolute value in the way of purely negative testimony.

Hegar regards as a valuable early sign of pregnancy the softening

* A pellicle, formed upon the surface of the urine, twenty-four to forty-eight hours after emission, was once regarded as of great diagnostic value. It received the name of kiesteine, and has been found to consist of a proteine substance, triple phosphates, fungi, and infusoria. It is not invariably present in the urine of pregnant women. It may occur at other times, and has even been found in the urine of the male.

and compressibility of the lower uterine segment as contrasted with the firm tissues of the cervix and the fundus. To determine its existence, the thumb should be introduced into the vagina, and the index-finger into the rectum as far as the pocket of the third sphincter ani. The fundus should then be pushed downward by pressure exerted through the abdominal walls, when the fundus, the lower uterine segment, and the cervix all are brought within the reach of the index-finger. The sign, however, is not conclusive, as its absence has been observed in early pregnancy, and a condition closely simulating it has been noticed in certain morbid states of the non-pregnant uterus.*

The changes in the *os* and *cervix uteri* are of great value in deciding the question of pregnancy. They consist of softening and œdematous swelling of the cervix, velvety character of the mucous membrane, associated with increased cervical secretion. In primiparæ the external orifice, instead of offering the sensation of a transverse slit, feels circular. In multiparæ the tip of the finger penetrates to a greater depth than in its former state. During the first two months the changes are rarely sufficiently marked to distinguish them from conditions that obtain at or near the menstrual period.

Quickening is the term used to designate the earliest movements of the fœtus perceived by the mother. They are at first slight, and have been compared "to the tremulous motion of a little bird held in the hand" (Montgomery). Modern investigations place the time at which the fœtus first begins to employ its muscles at about the tenth week. It is, however, somewhat rare for these movements to excite the attention of the mother before the sixteenth to the eighteenth week, though experienced matrons may recognize them at an earlier period. Hyperæsthetic women do so, I should say, as a rule. The clear statements of intelligent women leave me no reason to doubt that they may feel life as early as the twelfth week. At first the sensation is that of a flutter or tap, but the intensity of the movements is increased as pregnancy advances. They are rendered more active by a long fast, and by certain positions in bed. For considerable periods during the day they disappear altogether. Occasionally they may be suspended for days or weeks at a time, without the life of the child having become necessarily compromised. Cases have been cited in which women have never recognized the feeling of quickening throughout the entire period of pregnancy. Dropsy of the amnion and ascites are said to obscure the sensation of the fetal movements.

The subjective impressions of women as to quickening require, however, to be received with reserve. Instances are not infrequent where sterile women, misled by their eager longings for maternity, have not only deceived themselves, but have succeeded in betraying

* *Vide Compes*, Berliner klinischer Wochenschrift, No. 38, 1885.

their medical advisers into error by their confident assurances of having distinctly felt the movements of the child in the womb.

Fetal movements, on the other hand, when recognized by the medical expert, furnish conclusive evidence of pregnancy. These movements may be *active* or *passive*. *Active movements* may be detected by the eye, or by immediate contact. They seldom assume much distinctness before the sixth month, though this is not invariably the rule. (Thus, a patient of mine, the mother of six children, aborted at the fourth month. The ovum was expelled on the 27th of March. She gave birth on the 25th of December following—i. e., just nine months later—to a full-term child. In the latter part of July the movements were clearly appreciable to both the sight and touch.) At first the sensation is that of a simple pat or throb, but in the sixth and seventh months the limbs may be felt to escape from under the hand with a rolling or gliding movement. In the last two months, in women with lax abdominal parietes, it is sometimes possible to seize with the fingers a limb of the fœtus, especially when it chances to form a projection recognizable through the intermediate coverings. The fetal movements have been closely simulated by the irregular and spasmodic action of certain of the abdominal muscles. In the celebrated case of Joanna Southcote, who at the age of sixty-four claimed to be with child by the Holy Ghost, Dr. Reece says, "I felt something move under my hand, possessing a kind of undulatory motion, and appearing and disappearing in the same manner as a fœtus."*

Ballottement is the term applied to the *passive movements* communicated to the fœtus by the physician. It may be performed either by impressing the uterine contents with the two hands laid upon the abdominal wall, so as to cause the intervening body to float between them; or by introducing two fingers into the vagina and pushing them suddenly against the lower segment of the uterus just anterior to the cervix. When this is done, the head, if the presenting part, is made to bound away from the fingers, to drop down again in a few moments upon them with a gentle tap. Vaginal ballottement can sometimes be practiced successfully as early as the latter part of the fourth month. Ballottement is to be regarded as positive proof of pregnancy, as there is no other condition in which a solid body is found floating in the uterine cavity.

The important *auscultatory* signs consist of the *uterine bruit* and the sounds of the *fetal heart*. The discovery of the latter was made by M. Mayor, a surgeon of Geneva, as appears by the following note contributed by the editor of the Bibliothèque Universelle, in speaking of the *compte rendu* made by Percy, June 29, 1818, to the Academy of Sciences, upon the memoir of Laennec relative to auscultation:

* Montgomery, Signs of Pregnancy, second edition, p. 144.

"This observation reminds us of one made by M. Mayor, which has appeared very interesting to us in its connection with the art of midwifery and legal medicine. He has discovered that it is possible to recognize with certainty whether a child is living or no, by applying the ear to the abdomen of the mother of the child; if the child is living, one can hear very well the beatings of its heart, and distinguish them from those of the maternal pulse." * Time has served only to confirm in the most complete manner the accuracy of this statement. The heart-sounds of the fœtus, when once clearly heard, are now regarded as the most valuable of the signs of pregnancy, and conclusive evidence that the child is alive. They are, like those of the mother, distinctly double, and have been aptly compared by Kergaradec to the tick-tack of a watch. They are much more rapid than the corresponding sounds in the heart of the mother, oscillating between 120 and 160 per minute. They may be temporarily increased in frequency by movements of the mother, and by both the active and passive movements of the child. At the beginning of a pain, especially after rupture of the membrane, the heart-sounds often become more frequent; on the other hand, they become slowed during the height of the contraction, and may even for the moment cease altogether, either in consequence of the compression of the child's body, or as the result of the disturbance produced in the placental circulation. In the interval between the pains, the average frequency is usually restored. If at any time the frequency of the heart-beat permanently either rises above or falls below the normal average, the child's life is to be regarded as endangered. As the fetal circulation is entirely independent of that of the mother, there is no direct relation between the rapidity of the pulsations of the fetal and maternal hearts. However, in the febrile affections of the mother, the health of the child may become coincidently deranged, with resulting increase in the frequency of its heart's sounds. In general, the heart beats more frequently in girls than in boys—a circumstance probably owing to the average smaller size of the female at birth. In fifty observations, Frankenhaeuser † found the average in the boys was 134, while that of the girls was 144. He believed, therefore, that it would prove possible to predict the sex of the child *in utero* three months previous to confinement. Subsequent experience has demonstrated, however, that prophecies based upon the frequency of the heart-beats are at best of only approximative value, and that it is the part of wisdom to reserve a prognosis which may be falsified by time.

The fetal heart may generally be made out by the eighteenth to the twentieth week. Under favorable circumstances it has been detected as early as the fifteenth to the sixteenth week. It is usually

* Joulin, Traité complet d'accouchement, 1867, p. 410.

† Monatsschr. f. Geburtsk., Bd. xiv, p. 161.

heard over the dorsum of the fœtus; in face-presentations, on the contrary, it is heard most distinctly over the anterior surface of the thorax. The sound is often obscured by the thickness of the abdominal walls in fat women, and by an excessive amount of amniotic fluid. When the dorsum of the fœtus is turned posteriorly, it may be absent altogether. It is customary, therefore, to make frequent examinations at intervals before deciding, in consequence of its failure, upon the death of the child.

The *uterine bruit* is a blowing sound synchronous with the maternal pulse. It resembles strongly the souffle heard in aneurismal tumors, and varies greatly in quality and intensity. It is apt to be louder in markedly anæmic women. During the uterine contractions it possesses more of a musical character; at the height of a pain it may disappear for the moment. It may be modified by the pressure of the stethoscope or arrested altogether. When first discovered by Kergaradec (1822), it was attributed to the utero-placental circulation, and was therefore termed the placental bruit. As, however, it was found to persist two or three days after delivery, it became evident that the sound must be of uterine origin. It is now the generally accepted belief that the sound is produced in the ascending branches of the arteria uterina. Rotter* and Rapin have shown that, in pressure along the course of the artery, both when made through the abdominal walls and through the vagina, a vibratory thrill may be experienced by the touch, which corresponds to the sounds heard in auscultation.

It is seldom heard before the fourth month. Spiegelberg † states that, in women with lax abdominal parietes, he has succeeded, by pressing the stethoscope, placed above the symphysis pubis, deep downward so as to reach the sides of the lower portion of the uterus, in detecting the murmur as early as the eighth to the ninth week. As a sound similar to the uterine bruit may sometimes be detected in uterine fibroids, its value as a distinctive sign of pregnancy is thereby greatly impaired.

A hissing sound synchronous with those of the fetal heart is sometimes heard in auscultating the abdomen. This sound is referable to the umbilical cord, and is termed the *funic souffle*. Its etiology is a matter of conjecture. As it is only found in fourteen to fifteen per cent of cases examined, it possesses moderate value as a sign of pregnancy.

It is sometimes possible to detect the sound of the fetal movements as early as the fourteenth to the sixteenth week, i. e., a month earlier than the sounds of the fetal heart. It possesses a rubbing, crepitant character, resembling, according to Schulze, the sound pro-

* Rotter, Ueber fühlbares Uteringeräusch, Arch. f. Gynaek., p. 539.

† Lehrbuch der Geb., p. 104.

duced when the thumb is placed over the ear and the nail is scraped by the nail of another finger.*

Interrogation of the Patient.—In all cases of presumed pregnancy it is customary to commence an investigation by preliminary inquiries as to the existence of the more important subjective symptoms. As such are to be regarded the suppression of the menses, the so-called "morning-sickness," salivation, pricking sensations and lancinating pains in the breasts, enlargement of the abdomen, and quickening. As we have already seen, however, none of these symptoms are really decisive. Patients, by their statements, may in perfect good faith lead the physician into error; or, where they have an interest in practicing deception, may deny the existence of incriminating symptoms altogether. It is, therefore, often necessary to supplement the testimony of patients by the evidences to be obtained by a clinical examination. Ordinarily the vaginal touch suffices. In a few cases of doubt it may be necessary to possess one's self of all the objective signs before arriving at a conclusion.

Methods of Physical Exploration.

The patient may be examined in the upright or in the recumbent position. In the upright position, the physician may first examine the breasts, with reference to the existence of the changes characteristic of pregnancy. With the eye he takes note of the œdema and discoloration of the areola, the development of the follicles, the secondary areola, and the increased size of the organ. To distinguish from the enlargement of the breast due to adipose tissue, he looks for the presence of developed veins upon its surface, and with the touch recognizes the knotty, uneven feel produced by the development of the glandular tissue. By pressing the breast near the nipple between the thumb and index-finger the presence of milk may be determined.

An examination *per vaginam* is sometimes made in the upright position, in cases where the physician desires simply to rapidly acquaint himself with the condition of the generative passages and the lower portion of the uterus. The patient either stands with the feet apart, or with one foot raised upon a stool, while the physician, kneeling before her, encircles her hips with the left arm, and with the right hand passed beneath the clothing makes the requisite exploration. This method furnishes incomplete results, and is apt to offend sensitive patients. It possesses no advantages over that in the recumbent position, and is rarely resorted to except in the hurry of office practice.

Although for certain purposes it may prove advantageous to choose the lateral or knee-chest position, in all ordinary cases it is advisable

* J. Veit, Müller's Handbuch, vol. i, p. 311.

to examine the patient upon her back, as being most convenient for both external, internal, and conjoined exploration.

In the dorsal position the body should be as nearly horizontal as possible, with the head and shoulders resting upon a pillow, and the thighs flexed at right angles to the body and separated from one another. In this way the greatest possible relaxation of the abdominal walls and of the perinæum is attained. Corsets, or other articles of apparel interfering with freedom of investigation, should be removed. The woman should be covered with a sheet, and the clothes reflected upward so as to expose the abdomen. Where actual inspection is not necessary, it is well to draw the chemise smoothly over the abdominal walls, to avoid offending the modesty of the patient. When it is of importance to survey the external surface, care should be taken to so arrange the sheet as to cover the pubic region.

Inspection of the abdomen enables us to recognize its form and shape, the coloration of its surface, the striæ due to distention, and the condition of the navel. A flattening of the abdomen at the umbilical region, with bulging at the sides, would lead to the suspicion of ascites. A depression of the navel is incompatible with advanced pregnancy. Fetal movements are sometimes visible through the abdominal parietes.

Palpation of the abdomen enables us—1, to recognize the size, shape, and consistency of the uterine tumor, and to distinguish it from other intra-abdominal growths; 2, to ascertain, in advanced pregnancy, the presence of the fœtus. In a very large number of cases palpation alone serves to establish the existence of pregnancy. It is, however, only after the third month of pregnancy, when the fundus uteri can be felt above the symphysis pubis, that this method of exploration becomes available.

In its performance the physician stands by the side of the patient, and with the tips of his fingers rapidly traverses the abdomen from the pubes upward. In this way he takes note of the thickness of the abdominal walls and of the general position of the uterus. The latter may then be outlined by pressing the abdominal walls inward to the sides of the uterus, with the ulnar borders of the two hands. The uterus is then steadied with one hand, while, with the other, intermittent pressure is made to determine the consistence of the tumor. In pregnancy, after the second month, the uterus becomes soft and elastic, a condition that increases with the growth of the ovum, so that, toward the end, palpation often furnishes an obscure sense of fluctuation. The physician should next turn his face toward the feet of his patient, and make deep pressure above the symphysis pubis to the lower borders of the uterus. He should here seek to discover the vibratory thrill, which may sometimes be detected along the course of the uterine arteries. At the same time, in head-presentations (after

the sixth month), a hard, round body can generally be felt, and made to float to and fro between the examining fingers of the two hands. In thin persons, with relaxed abdominal and uterine parietes, it is possible, in the later months, to trace upward the back, the breech, and the extremities of the fœtus. The dorsal surface may be rendered more distinct by pressure on the breech, so as to augment the dorsal curve (Budin). During the progress of the examination in advanced pregnancy, the movements of the child are usually excited, and are readily appreciated.

The Differential Diagnosis of Pregnancy.

The differential diagnosis between pregnancy and other sources of abdominal enlargement is in most cases not difficult. In subperitoneal myomata of the uterus, the unevenness of the surface and the hardness of the tissues are distinctive. But it must be remembered that myomata, though they commonly cause sterility, do not actually exclude pregnancy. In the rare cases in which myomata and pregnancy coexist, the diagnosis for a time may be doubtful.

Braxton Hicks* lays great stress on the fact that, from the third month to the completion of labor, spontaneous contractions of the uterus take place, lasting generally from one to two minutes, and occurring at intervals of from five to twenty minutes. This enables us to determine the fact of pregnancy, and that the pregnancy is intrauterine. It occurs likewise in degenerations of the ovum, and in cases of a dead fœtus. He found, too, that where pregnancy coexisted with myomata the exact relations of the uterus were readily made out by the alteration which occurred at short intervals in the density of the uterus.

It is therefore important, where any uncertainty exists, to abstain from the use of sounds and to await the result of a future examination. In a few weeks' time the rapid growth of the pregnant uterus, quickening, ballottement, and the fetal heart will furnish the necessary data for establishing the distinction.

Ovarian cysts, in the early stages of their growth, occupy a position to the side of the pelvis, and are hardly likely to be confounded with the pregnant uterus. When, however, by their increase in size, they fill the abdomen, the history of ovariotomy shows that, without a full and complete examination, such a mistake is possible. Where ovarian cysts are complicated by pregnancy, the latter has been at times overlooked, simply because it was not so much as suspected. Thus, a young servant-girl was sent to me some years ago to consult me relative to the nature of an abdominal tumor. The diagnosis of ovarian cyst was readily established. A year later she sought the advice of a

* Trans. Internat. Med. Congress, 1887.

surgeon, formerly of this city, who counseled its removal. Having obtained her consent, he made the usual incision in the median line, and exposed, to his horror, the pregnant uterus. He afterward learned that the girl, having been assured that conception was impossible on account of the ovarian disease, had yielded to the solicitations of her lover. Finding herself pregnant, she purposely concealed her condition, and had sought the operation when seven months advanced, in the hope that a fatal issue would cover her shame. The ovarian tumor was left untouched, and the wound was quickly closed. The girl died, however, a few days afterward. In this case, the undoubted presence of an ovarian cyst and the reputable character of the girl combined to disarm suspicion.

In ovarian cysts there is, on palpation, ordinarily greater distinctness of fluctuation than in the gravid uterus. The diagnosis is, however, mainly based upon the presence or absence of the usual signs of pregnancy.

Thick layers of fat in the abdominal walls and ascites could hardly be mistaken for pregnancy, though they may serve to obscure palpation.

Tympanitic distention is recognized in part by the character of the percussion note, and in part by demonstrating the absence of the uterine tumor. The latter is accomplished by directing the patient to make alternate deep inspirations and prolonged expirations. The physician then places the left hand upon the abdomen. During the long inspiration he remains passive; with the expiration, he presses with the fingers of the right hand, placed obliquely against those of the left, in the direction of the spinal column. With the recurrence of inspiration, he holds steadily the ground previously gained. During the following expiration further progress is made, and thus by successive advances, in case no intervening body prevents, the hand is made to sink inward until the vertebræ are felt.* In cases of undue sensitiveness of the abdominal walls, chloroform may be administered to complete anæsthesia. Some patients, by means of contractions of the abdominal muscles, succeed in producing the semblance of a tumor, which may even be mapped out with the hands applied to the abdomen. These so-called "phantom tumors" occur most commonly in hysterical women who are earnestly desirous of becoming mothers. They are eminently calculated to entrap the unwary, if the examination be confined to the abdomen or to listening to the patient's subjective symptoms. They flatten down and disappear under chloroform, or when the attention is distracted during the course of an investigation.

Auscultation furnishes the most certain evidences of the existence of pregnancy. The stethoscope may be employed, or the ear may be

* This valuable method is borrowed from Professor SPIEGELBERG's Diagnose der Eierstocktumoren, Volkmann's Samml. klin. Vortr., No. 55.

applied directly to the abdomen. To hear the fetal heart requires a certain amount of practice, but the art can be readily acquired. As the sounds are, at best, of feeble intensity, the utmost stillness in the neighborhood of the patient is necessary for this appreciation. They are always heard with great difficulty before the end of the sixth month. There is no special point at which they can be invariably distinguished. In head or breech presentations, with the back of the fœtus curved and in contact with the uterine wall, the sounds are most clearly to be made out over its dorsal aspect. In face-presentations, on the contrary, the anterior surface of the child is pressed against the uterine walls, and the sounds are heard with the greatest distinctness over the chest. As in the last three months of pregnancy the cephalic presentations, with the back to the left, preponderate, the heart-sounds are oftenest heard in a line extending from the anterior superior spinous process to the umbilicus. When the back of the child is turned to the right, they are likewise directed somewhat posteriorly. The heart-sounds are then less accessible, and therefore appear feebler. Care must be taken not to confound with the fetal heart the conducted heart-sounds of the mother, or the aortic pulse. Thick abdominal walls, or abundant amniotic fluid, may interfere with the recognition of the heart-sounds. When the back of the child is turned to the rear, or during a uterine contraction, they may disappear altogether. If the child be living, however, repeated examinations will not fail to detect them. The uterine souffle is heard with maximum intensity to the sides of the uterus. In the early months it is to be sought for near the median line, just over the symphysis pubis.

The vaginal touch enables one to effect an examination of the genital canal and that portion of the uterus which is contained within the pelvic cavity. The accoucheur should accustom himself to use either hand with equal ease, and to conduct an examination upon whichever side of the bed his patient chances to be lying. The index-finger should be anointed with cold cream, lard, butter, vaseline, oil, or simple soap and water, to make its introduction into the vagina less painful. As the hand is passed under the clothes, it is a good plan to cover the index with the thumb and remaining fingers, to prevent its soiling the patient's wearing-apparel. The patient should now be told to separate her knees widely, while the index-finger glides forward over the perinæum to the introitus vaginæ. Note should be taken here of the size and direction of the orifice, and the degree of resistance offered by the external parts. Where there is much hair about the pubes, the introduction of the index-finger into the vagina is greatly favored by separating the labia with the fingers of the other hand. As the finger enters the vagina, it is well to notice the urethra, the condition of the rectum (whether filled with faeces), the length and width of the vagina, and the amount of lubricating secretion furnished

by the vaginal walls. To explore the anterior half of the pelvis, close the unemployed fingers upon the palm of the hand, direct the palmar surface of the index-finger to the front, and press upward to the presenting part. In the early months, place the unemployed hand upon the abdomen above the symphysis pubis, and, by conjoined manipulation, make out the size, shape, and consistence of the uterus. If pregnancy is sufficiently advanced, ballottement may be produced. To reach the cervix, the finger should be next turned to the rear. Many practitioners prefer to extend the previously closed fingers, and press them opened against the perinæum. Should the cervix not be readily reached, the examination should be made with both the index and middle fingers. If the middle finger is introduced slowly and with care, it gives no additional pain, and increases the reach by nearly an inch. The actual distance to the cervix may be diminished by placing the closed hand under the extremity of the sacrum, so as to diminish the degree of pelvic inclination. It is often necessary to resort to this measure when, toward the end of pregnancy, the cervix is situated unusually high up and is directed well to the rear. With the touch, we recognize the size and thickness of the cervix, the length of both the anterior and posterior walls, the shape of the os, and, if open, the character of the cervical canal.

The rectal touch is only necessary where there is obliteration of the vagina—a condition which does not exclude pregnancy, but it is sometimes usefully resorted to in other cases to complete information obtained by vaginal exploration.

The bluish coloration of the vulvar and vaginal mucous membrane is of considerable diagnostic importance. Chadwick* has recently drawn attention to the value of simple inspection of the vaginal orifice, without employment of the speculum. A faint diffused bluish tint he regards as suggestive; a faint bluish tint limited to the anterior vaginal wall he regards as characteristic and diagnostic; while a deep blue tint is a nearly absolute proof of pregnancy. The sign is often available as early as the end of the second month. Chadwick's tables show that in the second half of pregnancy the color is of such a character as to be in the rule diagnostic. My own experience is entirely in accord with that of Dr. Chadwick. In many instances where pregnancy had been concealed or not suspected, this sign has served me as a warning against the performance of an operation contra-indicated by the pregnant state.

Distinction between First and Subsequent Pregnancies.

In women who have once completed the full term of utero-gestation, the imprints left by the pregnant state are indelible and easy to

* Chadwick, Vaginal Coloration in Pregnancy, Trans. Am. Gyn. Soc., p. 399.

recognize. As it is sometimes a matter of forensic importance for a physician to be able to distinguish between first and subsequent pregnancies, it is desirable for every practitioner to make himself familiar with the characteristic differences between the two conditions.

In *primiparæ* the abdominal integuments are firm and tense, so that it is difficult to map out through them the underlying uterus, or to feel the head, the breech, or the limbs of the child. The striæ found upon the abdomen, the nates, and the thighs appear late in pregnancy, and have a reddish-brown or slaty color. The breasts are full, firm, and sensitive to pressure. The labia are in apposition, and the frænulum is intact. The hymen is torn, but each fragment remains attached in its entirety to the introitus vaginæ. The urethra is hypertrophied, and appears as a cylindrical body, of a reddish-blue color, in the vaginal orifice. The vagina itself is narrow, with distinct transverse ridges, and oftentimes possesses a granular feel, from the enlargement of the papillæ. The vaginal portion of the cervix is soft. When the head enters the pelvis, toward the end of pregnancy, shortening of the anterior lip takes place. The os externum is closed, or, not infrequently toward the close of gestation, admits the passage of the extremity of the examining finger. It then feels like a round opening, with smooth borders, and a sharp inner edge at the point where it joins the cervical mucous membrane. The cervical canal has a spindle-shape. The head, in the latter months, as a rule, sinks into the pelvis, and bulges the vagina.

In *women who have already borne children* the skin of the abdomen is loose, wrinkled, and can be gathered into folds by the hands. The uterus is likewise relaxed, and through its walls can be felt, in many cases, the projecting parts of the fœtus. The uterus is easily defined. In addition to the striæ upon the abdomen, noted in primiparæ, many of older date, possessing a shining white or silvery appearance, can be made out. The breasts are flabby, pendulous, and marked with silvery lines. The vulva gapes open, and wears a bluish aspect from the development of the superficial veins. The frænulum is usually found to have been lacerated. The caruncuiæ myrtiformes alone remain as vestiges of the hymen.* The vagina is smooth, from the obliteration of the transverse ridges. Swelling of the vaginal papillæ is exceptional. The cervix is swollen, and has a cylindrical rather than a conical shape. At times it is like a cone, with the base downward. The os is open, and admits the extremity of the finger. This patulous condition is due to lacerations of the cervix, which are the inseparable concomitants of child-bearing. The lacerations differ greatly in degree, but are rarely difficult of recognition. As they are situated usually on the sides of the cervix, they convert the os into a wide, transverse slit, bounded by a well-defined anterior and posterior

* *Vide* p. 6.

lip. The cervical canal has a funnel-shape, narrowing above. In the ninth month (in some cases earlier) the finger passes readily through the os internum to the child's head. The latter rarely descends into the pelvis before the advent of labor, but either is situated at the brim, or rests upon one of the iliac fossæ.

It should be added, finally, by way of caution, that while the presence of the foregoing signs speaks plainly in favor of the existence of a previous pregnancy, their absence is not absolutely incompatible with the occurrence of a premature labor, or even, in rare cases, with the delivery of a small fœtus at full term.

The Diagnosis of the Death of the Fœtus.

The presence of a dead child *in utero* may be inferred where active movements are not elicited by palpation, or where the heart-sounds, after repeated trials, can not be made out. As we have seen, a number of conditions sometimes combine to temporarily render it impossible, even when the child is living, to obtain positive results by auscultation. A decision should not, therefore, be based upon the results of an isolated examination.

In the earlier months, previous to the period when the fetal heart can be heard, the death of the fœtus is rendered probable by flabbiness and diminution in size of the uterus, by a flaccid condition of the breast, and certain subjective sensations experienced by the mother, such as languor, chilliness, bad taste in the mouth, and the feeling of a weight like a foreign body in the hypogastrium. Certainty is obtained when, through the open cervix, the cranial bones can be made out, and are found loose and movable within the integuments.

The Duration of Pregnancy.

There is no question in obstetrics upon the solution of which so much ingenuity has been expended as the determining of the normal duration of pregnancy. Inasmuch as it has proved impossible to ascertain the precise moment in which conception (i. e., the fertilizing of the ovum by the spermatozoa) takes place, it has been customary to assume as the starting-point for the reckoning of gestation either the date of the last menstruation or that of a single fruitful coitus. It would seem at first as though the latter would lead us to more nearly accurate results. But, aside from the fact that the distance of time between insemination and conception is avowedly variable,* it is only in rare cases that the particular coitus which has resulted in pregnancy can be definitely ascertained. Duncan collected 46 cases in which connection took place during a single day only, and found the

* Duncan, Fecundity, Fertility, and Sterility, second edition, pp. 433, 435.

average time to the date of parturition was 275 days. Ahlfeld, from an analysis of 425 cases, obtained an average of 271 days.* In 108 cases furnished by Hecker the average was 273·52 days.† Veit published 43 cases, with an average of 276·42 days.‡ In 63 cases of Faye's the average was 270·66.# Undoubtedly many of the cases included in these tables are of questionable reliability; two of them, indeed, in which confinement is reported to have followed coitus, respectively in 329 and 330 days, evidently belong to the realm of fable. Assuming, however, that the size of the tables serves to nearly neutralize specific inaccuracies, the small value of the averages obtained, as a means of predicting the date of confinement, is shown by the wide differences between the terms of gestation in the individual cases of which the tables are composed. Thus, in Ahlfeld's table there existed, between the longest and shortest gestation, a difference of 99 days; in Hecker's, a difference of 63 days; and in Veit's, a difference of 36 days. In the breeding of domestic animals, in which conception, as a rule, follows a single act of sexual congress, similar variations are common. In the now familiar observations of Tessier, Krahmer, and Spencer, the average duration of gestation in rabbits is 31 days, the variation 8 days; in sheep, pregnancy averages 151 days, and the variation amounts to 26 days; in cows, the average time of gestation is 283 days, but calving may occur between the 183d and the 356th day; in mares, the average time is 347 days, but foaling may occur between the 287th and the 419th day.‖

However, Ahlfeld's tables show that the bulk of confinements vary within narrow limits. Of 653 women, in 15·93 per cent delivery occurred in the thirty-eighth week; in 27·56 per cent, in the thirty-ninth week; in 26·19 per cent, in the fortieth week; and in 10·01 per cent, in the forty-first week. In other words, more than half the cases occurred in the thirty-ninth and fortieth weeks, and 80 per cent between the thirty-eighth and forty-first week inclusive. Of the remainder, 14 per cent took place prior to the thirty-eighth week, and were probably influenced by the many operative accidental causes which favor prematurity. Of the 6 per cent reported as occurring later than the forty-first week, a considerable number are of question-

* Beobachtungen über die Dauer der Schwangerschaft, Monatsschr. f. Geburtsk., Bd. xxxiv, p. 208. Ahlfeld's actual reckoning gave an average of 269·91 days, but this was afterward corrected by Löwenhardt, who found Ahlfeld's tables really furnished an average of 270·94. *Vide* Löwenhardt, Die Berechnung und Dauer der Schwangerschaft, Arch. f. Gynaek., Bd. iii, p. 458.

† Ahlfeld, *op. cit.*, p. 208.

‡ *Ibid.*, p. 210.

Other tables may be found in Montgomery, Signs of Pregnancy, second edition, pp. 493 *et seq.*

‖ *Vide* Ahlfeld, *op. cit.*, p. 216; St. Cyr, Traité d'obstétrique vétérinaire, pp. 107 *et seq.*

able authenticity. Gestation protracted beyond the two hundred and eighty-fifth day is certainly of very rare occurrence.*

Prediction of the Day of Confinement.

In all schemes for predicting the date of confinement, it is customary to throw out, as defying calculation, the exceptional cases, which fall much below or greatly exceed the usual average. No scheme is ever likely to be devised which will insure accuracy with regard to the day upon which labor will occur. In every scheme it has been assumed that errors of from four to five days are inevitable. Moral emotions, fatigue, attacks of indigestion, mechanical causes, and the like, are recognized as liable, toward the end of gestation, to precipitate labor at any time. But a vast deal of ingenuity has been expended in the endeavor to reduce ordinary errors within the narrowest limits.

The Last Menstruation.—Now, it has already been remarked that it is only in rare cases that the day of conception (i. e., insemination) can be utilized. In all calculations of the duration of pregnancy, it has been customary, therefore, to select the menstrual period as the starting-point. As the days immediately following menstruation are those in which conception usually occurs, the end of menstruation has been adopted by some as the most suitable point of departure. Ahlfeld estimated that 35·55 per cent of married women conceived on the last day of menstruation, and that 88·44 per cent conceived within twelve days, counting from the first of menstruation.† Experience has shown, however, that there is no single day in the intermenstrual period in which conception may not occur. Jewish women, indeed, who are forbidden sexual intercourse by the Mosaic law during menstruation and the seven days following, are proverbially fruitful. Löwenhardt has shown that, though in two women conception follows in each a single act of coitus, occurring the same number of days after menstruation, there is no necessary correspondence of the date of confinement in the two.‡

As, therefore, there is little to be gained by estimating the day of confinement from the probable day of conception, it has become the usual rule to reckon from the first rather than from the last day of menstruation, especially as most women exercise more care in preserving the record of the former date.

From the days of Hippocrates, it has been customary to regard

* Many cases of apparent protracted gestation find their explanation in the fact that conception may occur just prior to the menstruation period succeeding to that from which the count is made. In one instance, in which a lady was confined three hundred and six days after the last menstrual period, the statement was volunteered that for twenty days following menstruation "precautions" against pregnancy had been resorted to.

† Ahlfeld, *op. cit.*, p. 191. ‡ *Op. cit.*, pp. 461 *et seq.*

pregnancy as extending over ten lunar months, or ten menstrual periods of twenty-eight days each. In accordance with this idea, Naegele* proposed a ready method of computing two hundred and eighty days from any given date, which has since his time been generally adopted. This consisted in counting forward nine months, or, what amounted to the same thing, counting backward three months, and then adding seven days (in leap-years, after February, six) to the date chosen as the starting-point of the calculation. Naegele selected the first day of the last menstruation. His method is, of course, equally applicable, when the day of cessation is preferred as the point of departure. For seven months in the year Naegele's method is absolutely correct. In February, however, four days, in December and January five days, and in April and September six days only are required to complete two hundred and eighty days. Tables may be found in most physicians' visiting lists, by means of which the two hundred and eighty days may be determined at a glance. The following circle of Schultze is based upon Naegele's method. The figures between the radii show the exact number of days to be added for each of the months severally. The figures in parentheses are to be employed in leap-year.

Fig. 59.—Diagram for computing pregnancy. (Schultze.)

Unfortunately, the supposition that labor comes on after the expiration of ten menstrual periods of twenty-eight days each is correct for only a small number of cases, so that it has been found necessary to shift the ground somewhat to the position that the normal duration of pregnancy covers ten menstrual periods. The instability of the reckoning would then find its explanation in the common experience that ten consecutive periods of exactly twenty-eight days each are rare even in the most regular of women. Although ovulation is suspended during pregnancy, at the return of the menstrual epochs the existence of an ovarian influence upon the generative organs may be clearly traced in many individuals. At such times a sensation of fullness is often experienced in the pelvic organs, associated in some women with an awakening of the sexual appetite. At such times, too, there has

* Naegele, Lehrbuch der Geb., achter Auflage, p. 122.

been observed a tendency to miscarry, so that it becomes incumbent upon sensitive, impressionable females, predisposed to abort, to especially avoid either reflex or mechanical sources of disturbance during the continuance of the state under notice. When the ovum reaches maturity, the recurrence of the tenth menstrual epoch furnishes local conditions in a peculiar degree favoring the production of labor. Löwenhardt * found it was possible to calculate the duration of pregnancy in twenty-two individuals with tolerable accuracy, by assuming that ten menstrual periods represent not two hundred and eighty days, but ten times the length of time between the last menstrual period and the one immediately preceding it. In no case thus calculated did the error exceed five days, a degree of exactitude unattainable by the method of Naegele.

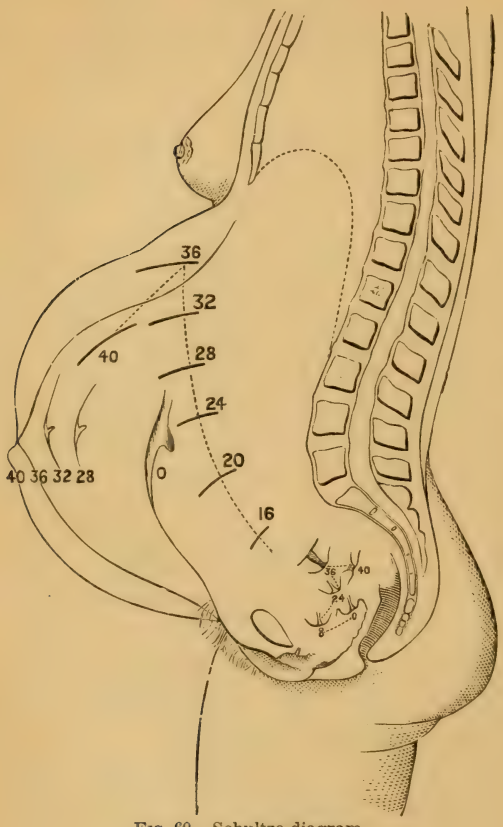


FIG. 60.—Schultze diagram.

The Date of Quickening.—When the date of the last menstruation can not be obtained, it is customary to reckon the time of labor approximately by adding twenty-two weeks to the date of quickening, which is assumed to occur in the eighteenth week of pregnancy. The extreme variation, however, in the time at which quickening occurs in different individuals renders this method of calculation a very uncertain one.

The Size of the Uterus.—As the increase of the uterus is progressive, its size is sometimes used in determining approximatively the

* Die Berechnung und die Dauer der Schwangerschaft, Arch. f. Gynaek., Bd. iii, p. 476. In quite a number of instances I have had curious confirmation of Löwenhardt's theory. Thus I can recall two cases where the menses recurred once in twenty-six days, and the apparent length of gestation was two hundred and sixty days. But the rule has many exceptions.

period to which gestation has advanced. According to a rude formula, commonly employed at the bedside, the uterus is, in the second month, of the size of an orange; in the third month, of the size of a child's head. In the fourth month, it can be felt above the symphysis pubis. In the fifth month, the fundus of the uterus rises to a point midway between the symphysis and the navel. By the sixth month, it reaches the level of the navel. In the seventh month, it should be the breadth of two or three fingers above the navel. In the eighth month, it rises half-way between the navel and the epigastrium. In the ninth month, it reaches the epigastrium. In the tenth month, two to three weeks before confinement, the uterus sinks downward and somewhat forward, so that its upper level corresponds very nearly to that of the uterus in the eighth month.

In the foregoing calculation most of the data are obtained from the relation of the fundus to the navel. But the navel is not a fixed point. Spiegelberg found the distance between the upper border of the symphysis and the navel varied in different women as much as six inches.* The average distance from the symphysis pubis to the fundus of the uterus in the different months of pregnancy he found was—

From the 22d to the 26th week	.....	8½	inches.†
" " " 28th week	.....	10⅓	"
" " " 30th week	.....	11	"
" " " 32d and 33d week	.....	11⅓	"
" " " 34th week	.....	12	"
" " " 35th and 36th week	.....	12⅔	"
" " " 37th and 38th week	.....	13	"
" " " 39th and 40th week	.....	13¼	"

But the size of the uterus is subject to considerable variations, due to the size of the child and the amount of the amniotic fluid.

* Lehrbuch der Geb., Bd. ii, p. 115.

† These measurements exceed considerably those furnished by Farre, p. 83. The discrepancies are due in part to the extent of individual variation, and in part to the fact that they were made with a tape-measure. Thus, Ahlfeld, employing the cyrtomètre of Baudelocque, found the distance from the symphysis pubis to the fundus only ten and a half inches in the fortieth week. Ahlfeld found the length of the child to be nearly double the distance between the head and breech when the child assumed the attitude usual in the uterus. To determine the date of pregnancy, he proposed to measure the axis of the fœtus *in utero*, by means of a cyrtomètre, one extremity of which, passed into the vagina, rested upon the child's head, while the other was extended to a mark upon the abdominal wall corresponding to the breech. He then sought to establish the length of a child at each week of pregnancy. His tables show, however, such variations in the size of children born in the same week as to impair the practical value of the method. *Vide* Ahlfeld, Bestimmung der Grösse und des Alters der Frucht vor der Geburt, Arch. f. Gynæk., Bd. ii, p. 353.

PREGNANCY.

CHAPTER VI.

THE MANAGEMENT OF PREGNANCY.

Hygiene of pregnancy.—The disorders of pregnancy.—The blood-changes of pregnancy.—Pernicious anæmia.—Hydræmic œdema.—Varicose veins.—Nausea and vomiting.—Heart-burn.—Insalivation.—Pruritus.—Face-ache.—Cephalalgia.—Insomnia.

In studying the effects of pregnancy we saw that, besides the local changes in the sexual apparatus and the disturbances produced by pressure, the organism had to adapt itself to a variety of new conditions, of which the most conspicuous were alterations in the quality of the blood and increase of its quantity, with additional work thrown upon the lungs and kidneys, and reflex derangements of the nervous and digestive systems. The physiological condition of the pregnant woman approximates so closely to what would be regarded as pathological at other times, that the necessity arises for the patient to carefully observe hygienic rules, while the physician often finds himself called upon to exercise his art in restraining distressing symptoms within limits consistent with the healthy progress of gestation.

The Hygiene of Pregnancy.—During the pregnant state, the increased elimination of carbonic acid by the lungs is necessarily associated with increased consumption of oxygen. This respiratory activity makes an abundance of fresh, pure air a matter of prime importance. As a rule, therefore, a rural neighborhood is more conducive to normal pregnancy than large cities. To be avoided are small, close, heated rooms, confinement indoors, and crowded assemblages.

The dietary should embrace all nutritious, easily digested articles of food. The natural tendency to acidity, heart-burn, flatulence, and colic is apt to be increased by indulgence in the products of the frying-pan and the dainties of the pastry-cook and confectioner. The consuming desire for unwonted articles of food, which is customarily termed "longings," I have never yet witnessed, and am tempted to regard as in a great measure mythical. A good appetite is the best safeguard against most of the discomforts of pregnancy. Owing, how-

ever, to the activity of the assimilative processes, a very moderate appetite is not incompatible with a considerable gain in weight. A very large appetite is not normal during pregnancy, and requires to be restrained.

The dress should be loose and easy. Garters and tight corsets should be discarded. When the projection of the abdomen removes the folds of the dress from the lower limbs, flannel drawers reaching to the waist should be worn as a protection.

Gentle exercise, not pushed to the verge of fatigue, should be encouraged. Walks and drives in the fresh air are the best means of fostering sleep and maintaining the appetite and general assimilative processes. Violent exercise, on the other hand, is liable to produce miscarriage. It is stated that the predisposition to miscarriage is greatest at the third and seventh months. Throughout pregnancy special care should be observed at the recurrence of the menstrual epochs. Long railway journeys at such times are a frequent cause of trouble. Marital relations, though not absolutely to be prohibited, should be of infrequent occurrence. Excesses in the newly married are a common source of abortion.

The skin should be kept in good condition by frequent bathing, as by its eliminative action it is capable of relieving the kidneys of a portion of the work thrown upon them. The increased vaginal secretion renders it important for the woman to frequently wash the external genitals. The vaginal douche is a source of comfort to many women, but the quantity injected should not exceed a pint of water, and should be introduced slowly, with every precaution in the way of allowing an immediate reflux to take place.

The increased irritability often observable in pregnant women calls for the greatest forbearance and gentleness on the part of those who are brought into close contact with them. Their unreasonableness is not to be cured by either impatience or stern treatment. It is the product of nervous derangement, and is to be regarded as due rather to physical than to moral fault.

The Disorders of Pregnancy.—Among women reared amid the refinements of civilization the entire period of pregnancy is very frequently attended with a great deal of discomfort. The attempt to relieve the disorders of pregnancy *seriatim*, it should be stated in a general way, is a vain undertaking, and is a good method to beget hysteria by fixing the female's attention upon minor ailments. The best medicines, in a large proportion of cases, are amusements and occupations calculated to produce a forgetfulness of self. When, however, the disorders of pregnancy advance beyond the stage of discomfort to that of actual suffering or danger, every effort should be put forth for their relief or mitigation.

The Blood-Changes of Pregnancy.—Under ordinary physiological

conditions, as we have noted, there is a natural increase of the red corpuscles in the blood during pregnancy; but as a consequence of faulty food assimilation, or of penury and want, there may be a loss of red corpuscles and of albumen. The red blood-corpuscles, as the oxygen-carriers to the tissues, are illy spared from the economy. When they have undergone destruction to any material extent, the cell-elements, whose vitality is intimately associated with the power to take oxygen from the blood, suffer from inanition, and the starved cells waste or fill with fatty molecules. These changes are of necessity followed by loss of weight, muscular prostration, impaired functional activity of the secretory organs, and increased nerve irritability. As a consequence, the appetite fails, the digestion is weakened, neuralgic pains develop, and even moderate muscular exertion is attended with effort and followed by a sense of fatigue; vertigo, loss of memory, and, in severe cases, chorea, hysteria, and insanity, may result from the deranged condition of the nerve-centers; attacks of syncope, palpitations, and præcordial oppression point to feeble heart-action; the arterial tension is lowered and venous hyperæmia results; and, finally, the stagnant blood, deprived of its albumen, in place of inviting endosmotic currents, transudes through the walls of the vessels, giving rise to œdema and dropsical effusions. Gusserow* (1871) called attention to the fact that the anæmia of pregnancy might progress to such an extreme as to produce a fatal termination.

The treatment of anæmia is largely prophylactic. Light, air, moderate exercise, good food, regulation of the bowels, cheerful society, and an occasional respite from household and family cares, will always be the main checks to its extreme development. Iron, though of little avail in repairing losses which have already taken place, is of the utmost value in limiting the progress of the malady. Iron reduced by hydrogen, in three-grain doses, either alone or combined with a fiftieth of a grain of arsenic, has rendered me most service in this affection. It should, however, be continued without intermission for weeks at a time in order to obtain the full advantage of its beneficent action. The liquid forms of iron, so useful at other times, I have rarely found tolerated for a lengthened period in the pregnant state. In weakened states of the stomach, when the latter revolts at beefsteak and mutton, easily assimilated albuminoid articles, such as milk, soft-boiled eggs, and scraped raw or underdone meat, should be administered in small but frequently repeated portions. Where the marasmus is extreme, and the rectum tolerant, the stomach may be relieved of a part of its duty by the use of nutritive enemata prepared in accordance with the now familiar prescription of Leube. In the pernicious form of anæmia, Gusserow tried transfusion, but without success. He recommended,

* Gusserow, Ueber hochgradigste Anaemie Schwangerer, Arch. f. Gynaek., Bd. ii, p. 218.

therefore, the resort to premature labor. In a case which occurred to me in hospital practice, before my attention was drawn to Gusserow's essay, I employed the latter method after consultation with my colleagues. The patient made a slow but apparently sure progress toward recovery, until, at the end of a month, she managed, in the temporary absence of the ward nurse, to get out of bed and make a hearty meal of corned beef and cabbage. Vomiting set in, followed by collapse, which proved fatal in a few hours. This pernicious form of anæmia, though not confined to multiparæ, develops most frequently in women who have borne many children in rapid succession.

A not unusual result of hydræmia consists in a swelling of the lower extremities, beginning at the ankles, and thence extending upward and invading often the labia, the vagina, and the lower segment of the uterus. When not associated with kidney complications, this œdema is rarely dangerous, though often the source of extreme discomfort. In some cases of œdema of the vulva, the labia may attain to the size of a man's head, and become nearly diaphanous from the serous infiltration. When the distention is extreme, gangrene may threaten and make it necessary to resort to puncture. In lying-in hospitals this should be done with every antiseptic precaution. With free drainage established, the swelling rapidly subsides. In a half-dozen cases which I have thus far treated in this manner, premature labor has followed in the course of two or three days—a coincidence of such frequent occurrence as to make it necessary to employ puncture with circumspection.

Œdema of the lower extremities seldom disappears entirely before confinement, though relief is sometimes experienced in the last month, when the fundus of the uterus falls forward. Slight degrees, such as swelling limited to the feet, making it necessary for the woman to go around in old shoes or her husband's slippers, do not require treatment. Where, however, the skin of the limbs becomes tense and painful, warm cloths should be applied, diaphoresis if possible should be induced, tonics should be administered, and the patient be kept in a recumbent position, or with the extremities raised *à l'Américaine*. Hydragogue cathartics, by still further impovishering the blood, tend to aggravate the difficulty.

Varicose Veins.—Varicose veins occur with greater frequency in multiparæ than in primiparæ. So long as the large veins are not involved, they possess slight significance. The saphena is always first affected, then the lateral branches upon the inner surface of the leg and thigh, especially just above the knee,* and less commonly the veins of the vulva. Dilatation of the hæmorrhoidal veins is a very frequent occurrence.

The treatment of varicose veins is limited to the adoption of meas-

* Spiegelberg, *loc. cit.*, p. 250.

ures to prevent their increase, and to provide against the dangers of rupture. The first indication is best fulfilled by regulation of the bowels and the wearing of elastic stockings. The subcutaneous injection of one to two grains of ergotin in solution has been recommended, and is reported not to awaken uterine contractions. As the danger of rupture is not speculative (Spiegelberg * reports two cases of fatal hæmorrhage from this cause), the patient should always be provided with a compress and bandage, which she should be taught to apply herself in case of a sudden emergency before professional aid can be obtained.

Nausea and Vomiting.—There are few known therapeutical agents which have not at one time or another been essayed as remedies for the nausea and vomiting of pregnancy. Some of them have even enjoyed for a time high repute as specifics, but the sobering effect of experience has invariably served to dispel illusive hopes, the most successful of them proving uncertain, and of benefit to only a limited class of patients. It is usually, therefore, the part of prudence to do nothing for the minor degrees of the affection, such as the ordinary morning-sickness, or even for continuous nausea, so long as the ingestion of food and the general nutrition of the patient are undisturbed. For these cases Seyfert's advice, to let the wife go home on a visit to her mother, implying the value of changed surroundings, furnishes a serviceable hint in the way of practice. When, however, the distressing symptoms continue after the first three months, and perceptibly tend to exhaust the vital powers, every resource should be tried in turn, in the hope that some one of the many in repute may prove of service as a means of warding off impending disaster.

At the outset of any systematic plan of treatment for pregnancy-vomiting, it is essential that the physician should inspire his patient with confidence in his ultimate success. Care should be taken to regulate the bowels, as constipation invariably aggravates existing gastric disturbance. Coitus often increases the sickness. If, in the early months, the uterus is found retroverted or retroflexed, it should be replaced in the knee-chest position, and the recurrence of the displacement should be prevented by a suitable pessary. Grailly Hewitt has likewise called attention to the fact that pregnancy-sickness may coexist with impaction of the uterus connected with marked anteflexion. In such cases relief is sometimes afforded by elevating the patient's hips and by pushing the fundus of the uterus upward with the finger. If necessary, the replacement should be maintained by cotton pledgets, or by Gariel's air pessary. A speculum examination should be made of the cervix, and, should it be found eroded, the raw surface should be brushed at intervals of from two to three days with a ten-per-cent solution of nitrate of silver. Collins (Lancet, Dec. 17, 1887) has

* *Ibid.*, p. 250. For a complete discussion of the subject, *vide* Des varices chez la femme enceinte, Thèse d'Agrégation, par le Dr. P. Budin.

caused the cessation of vomiting by a single application to the cervix of a ten-per-cent cocaine salve by means of a cotton tampon. In quite a number of cases a mitigation of the distress is obtained by applying the faradaic current to the pit of the stomach; in others, the ice-bag applied to the cervical vertebræ affords a considerable measure of relief; and again in still others the sickness is helped by spraying the pit of the stomach with ether. In hysterical patients Doléris recommends the shower-bath. The inhalation of oxygen has likewise been tried by Pinard with success. To many, ice-cold effervescent drinks are grateful. Dr. Fordyce Barker was wont to recommend carbonic-acid water containing a drachm of bromide of potassium to the siphon. Dry champagne is of assistance to a comparatively small class, but more often I have found it revolting to a squeamish stomach. Of medicinal agents, subnitrate of bismuth and the oxalate of cerium possess the widest application. Usually I order ten grains of the former, combined with five to ten grains of the latter, to be taken ten minutes before eating. In cases of gastric catarrh, my favorite is the tincture of nux vomica given in ten-drop doses before meals. Drop doses of Fowler's solution at meal-time are said to exert considerable influence in allaying stomach irritability. A twelfth of a grain of morphia given hypodermically or by the mouth will frequently aid the retention of food by the stomach, but may lead to the formation of the opium habit. Simmons, of Yokohama, advises the injection of thirty grains of chloral per rectum morning and evening, a practice of which Richardson advises further trial.* After eating, digestion may be promoted by ten grains of pepsin, given alone or with either the dilute muriatic acid or Horsford's acid phosphate. Gunther† states that he has caused the cessation of vomiting by the use of galvanism as follows: He placed the anode covered by a sponge to the cervix, and the cathode, by means of a large plaque, 4×8 inches, over the spine, between the eighth and twelfth vertebræ. In no case did the vomiting persist more than five days. The strength of the current was at first 2½ to 3 milliampères, and never exceeded 5 milliampères.

If the foregoing measures prove of no avail, the patient should be made to take small quantities of easily digested food, such as milk and lime-water, koumyss, Valentine's beef-juice, or the pulp scraped from raw or underdone beef, at hourly intervals, while rest in bed is maintained for the purpose of avoiding the slightest unnecessary waste of tissue.

In very rare instances the vomiting becomes incessant, and resists every remedy. If death from starvation threatens, it may become necessary, as an ultimate resource, to terminate pregnancy by artificial means. The severest cases rarely are such at the beginning.

* Richardson, Hydrate of Chloral in Obstetric Practice, Trans. of the Am. Gynæc. Soc. vol. i, p. 247.

† Centralblatt, 1888, p. 465.

Usually, at the outset, there is a period of nausea, followed by occasional attacks of easy, painless vomiting. But in time everything taken into the stomach is rejected. The patient experiences a disgust for all food, or, rarely, a craving for indigestible articles of diet. With this condition is often associated pains in the stomach and profuse salivation; constipation is common; diarrhœa is the exception. According to Horwitz, patients sometimes complain of unpleasant odors (hyperosmia). With the constant vomiting, they become wasted, pale, and apathetic. As exhaustion becomes marked, the pulse grows weak and rapid; the respirations are more frequent; the skin of the body becomes dry and hard; the extremities are cold and blue, and at times are covered with sweat. Now and then a slight elevation of temperature is observable. The vomited matter consists of mucus mingled with bile, and is sometimes tinged with blood. Toward the end constant thirst is felt, the mouth and throat are dry, the buccal mucous membrane is reddened, the tongue is red at the tip and brown at the root, sordes cover the gums and the teeth, and the breath has a most disgusting odor. The quantity of the urine sinks to a few ounces daily, is concentrated, and contains both albumen and casts, the latter ordinarily epithelial, but sometimes fibrinous. To the close of life extreme emaciation and weakness ensue, the face is pinched, the eyes are dull and sunken, fainting attacks are frequent, the sensorium is sometimes unobscured, but often there are hallucinations and delirium. Before life closes the vomiting ceases.

Remissions in the course of the disease are not uncommon. Sometimes the strength holds out to the end of pregnancy. The fœtus in these cases suffers but little from the exhaustion of the mother. In general, however, the prognosis is bad. Joulin has reported one hundred and twenty-one cases, with forty-nine deaths. Without treatment, of fifty-seven cases, twenty-eight were fatal; with treatment (abortion induced), of thirty-six patients, nine only died.

The treatment consists first in the careful removal of all complicating conditions. In the early stages it may be sufficient to resort to the measures already recommended. If the vomiting is literally uncontrollable, the patient should be placed at rest in bed. Every unnecessary movement should be avoided. Horwitz recommends that the room be darkened, and in advanced cases that warmth be applied to the body. Rectal alimentation is often capable of rendering excellent service.* Peptonized milk, defibrinated blood,† and the beef and

* Dr. Busey, in an article published in the Am. Jour. of the Med. Sci. (1879, pp. 112–117), advises stomach-rest, nutritive enemata, and the rectal administration of bromide of potassium. Later experiences have fully confirmed the value of his recommendations.

† We owe this excellent suggestion to Dr. A. H. Smith. The defibrinated blood should be administered warmed, three to four ounces at a time, once in eight hours.

pancreas solution of Leube,* may be used for this purpose. The quantity should not exceed four to six ounces, and should not be repeated more frequently than three to four times in twenty-four hours. Sometimes it is necessary that the stomach-rest should be absolute. It is, however, permissible for the patient to ease her thirst with bits of ice or small quantities of sparkling drinks when they are not immediately ejected. If the latter is the case, I administer eight ounces of water, with the addition of two whites of eggs, *per rectum* three times daily, in addition to the regular enemas. Usually it will be necessary to quiet the nervous system by some anodyne agent. Dr. Busey recommends the rectal administration of bromide of potassium. Horwitz and Sutugin press the claims of chloral. Codeia by the mouth and morphia hypodermically are of undoubted service in many cases. But the choice will have to be determined by the idiosyncrasy of the patient.

After the regular continuance for a few days of the rectal alimentation, attempts should be made to test the capacity of the stomach to retain solid food. Sutugin got good results from little balls of meat which he had cooked over a spirit-lamp. Small quantities of peptonized milk, or pancreatized solutions of meat, should be tried, though sometimes indigestible articles of food are found to be those which are really best tolerated.

Dr. Henry F. Campbell † relates a case where he nourished a patient fifty-two days by the rectum alone. Such cases are very rare, owing to the fact that in time the rectum becomes intolerant of the presence of injected materials. If, therefore, the rectal method of nutrition fails to relieve the patient, the induction of abortion or premature labor should be resorted to before the stage of extreme inanition is reached. But first in such a case it is well to recall the experience of Dr. Copeman, of Norwich, England. Desirous of exciting abortion (patient at sixth month), he pushed his finger upward through the cervix to the membranes. These he tried to rupture with a sound, but without success. Two hours later he returned to his patient, and found, to his astonishment, the vomiting had ceased. Later he tried the plan of dilating the os externum and cervix with the index-finger for the cure of persistent vomiting, and in four cases he succeeded by this method in removing the distressing symptom. In three subse-

To prevent decomposition, Dr. Smith advises the addition of a grain and a half of chloral to each fluidounce of the blood.

* Leube's formula consists of five to ten ounces of finely chopped beef, to which should be added one third its weight of finely minced pancreas (pig or ox). The mixture should be treated in a mortar with five ounces of lukewarm water, and reduced to a thick soup (Foster's Clinical Medicine, p. 24). Not more than four to six ounces should be given at a time, nor more frequently than once in four hours.

† H. F. Campbell, Rectal Alimentation in Pregnancy, Trans. of the Am. Gyn. Soc., vol. iii, p. 273.

quent trials he found that it was not necessary to press up to the os internum, but that it sufficed to pass the index-finger to the first joint. Rosenthal has since reported two favorable cases. Dr. W. Gill Wylie * believes that most cases of nausea may be cured by Copeman's method combined with treatment of any discoverable cervical lesion. He has devised a special steel dilator to take the place of the finger. His description of his plan of conduct is as follows:

"The vulva and vagina are carefully washed with a 1-to-3,000 solution of mercuric bichloride. I then dip the blades of my dilator in pure carbolic acid and shake off the free acid and introduce the points into the cervix for about half an inch, and slowly dilate until the blades separate from one third to one half an inch. If there is an eroded or everted diseased tissue present, I touch it lightly with an applicator that has been dipped in pure carbolic acid. I then, with a powder-blower, cover the cervix with a thin layer of iodoform, and place against the cervix a flat pledget of borated absorbent cotton soaked in pure glycerin, which is to be removed in twenty-four hours by means of a short string attached to it. In some cases there is slight pain, but in most cases no pain or real disturbance whatever is produced. As a rule, this will relieve nausea; but after four or five days, if there is still nausea, I repeat the dilatation, and may pass the dilator three fourths of an inch, and in some cases, where the cervix is long, even more. Very rarely will more than two dilatations be needed. In some cases the cervix is so patulous that dilatation may seem to be useless, but well up in the cervix tight bands may be found, and, when stretched, complete relief is effected. Even where the cervix is lacerated and apparently open, bands may be found, and, when stretched, relief is obtained. It is easy in such cases to recognize when the end of the dilator comes against the os internum, for it is firmly closed, and by passing the instrument until the os is felt, and then slightly withdrawing it, dilatation can be done without much risk. In severe cases the cervix may be of a very bluish-black color. The glycerin application causes a free watery discharge, and relieves this congestion. Formerly I used nitrate of silver for granular erosion, but I found that the carbolic acid and glycerin had an equally good effect."

Horwitz was less fortunate; still, the trial of the measure is justifiable, inasmuch as its failure does not aggravate the patient's discomfort, and does not measurably delay the resort to the artificial interruption of pregnancy. By the latter method, McClintock reports in thirty-six cases the saving of twenty-seven lives. It is obvious that the results are mainly determined by the condition of the patient at the time the operation is undertaken. In the advanced stages of the disease, after the tongue has become dry and brown, the urine scanty and albuminous, and when the wasting and prostration have reached

* Wylie, Vomiting in Pregnancy, N. Y. Med. Record, Dec. 6, 1884.

an extreme degree, it is hardly to be expected that many lives are to be rescued.*

For the induction of abortion in the early months I prefer the tupelo tents, as, with the softening and dilatation caused by the tents, the sickness usually ceases for a considerable period previous to expulsion of the ovum.

In deciding the question of abortion, it is necessary not to forget the neurotic character of the stomach sickness in many pregnant women. The complete cessation of the vomiting, deemed uncontrollable as the result of mental impressions, has been often noted by clinical observers. In one instance, owing to extreme exhaustion of the patient due to continued vomiting, I decided to induce abortion. As I was making preparations to that end, the patient, somewhat unexpectedly to myself, announced her determined opposition to the proposed plan of treatment. I endeavored to show her that it was necessary, to save her life. She asked me to hand her a cup of bouillon. As she swallowed it I told her there would be no occasion to induce abortion, if she kept it on her stomach. This she did seemingly without difficulty, and from that moment to the end of the pregnancy there was no recurrence of stomach sickness. A similar history is related by Kaltenbach.† In a paper on the excessive vomiting of pregnancy, Kaltenbach urges that in all cases especial stress should be laid upon the underlying disturbance of the nervous system. With this object in view, he recommends that the physician should seek to win the confidence of his patients in respect to methods of treatment prescribed and the efficacy of remedies employed. Often, to secure favorable results, it becomes necessary to isolate the sufferer from anxious and injudicious friends, and from the petty irritations of domestic life. "The more authoritatively the physician carries out his plans of treatment," he says, "the more rarely will he be driven to seek a cure in artificial abortion."

Heart-burn.—Heart-burn becomes distressing in the later months of pregnancy. It can rarely be cured before delivery, but may, in most cases, be palliated by carbonate of magnesia or half-teaspoonful doses of aromatic spirits of ammonia.

Salivation.—Excessive flow of saliva to the extent of two to three quarts in the course of the day has been observed. For this disorder small doses of atropia, the twelfth of a grain of pilocarpine, and the fluid extract of viburnum prunifolium have been severally recommended.

Pruritus.—Pruritus, without any visible affection of the skin, sometimes occasions in pregnant women an unendurable degree of suffering. When general, temporary relief may be obtained by placing the patient in a prolonged soda-bath, and subsequently rubbing the entire surface with vaseline. Very commonly the itching is con-

* For recent discussions of this subject, *vide* Horwitz, Ueber das unstillbare Erbrechen der Schwangeren, Ztschr. f. Geburtsk. und Gynaek., vol. ix. p. 110. Sutugin, Hyperemesis gravidarum, Berlin, 1883.

† Kaltenbach, Ueber Hyperemesis gravidarum, Ztschr. für Geburtsk. und Gynaek., Bd. xxi, p. 200.

fined to the distended abdominal walls. In such cases, cloths wet with camphor liniments, with the addition of chloroform (lin. saponis comp., ℥ v ; chloroform, ℥ j), or a solution of carbolic acid (ʒ j ad Oj), applied to the itching surface will usually allay the irritation for the time. In pruritus of the vulva, in addition to local external applications, great care should be taken to cleanse the vagina with solutions of borax or carbolic acid. A half-pint slowly injected into the vagina may be employed twice daily, without risk of provoking labor. If the itching results from an acrid discharge proceeding from an ulcerated cervix, the application of nitrate of silver, or the introduction at night of a cotton plug soaked in a solution of tannin in glycerin (ac. tannic., ʒ j ; glycerinæ, ℥ j), will usually afford relief.

Face-ache.—Neuralgia of the fifth nerve is a common affection in pregnant women. It can often be quieted by the external application of aconite, chloroform, or camphor liniment. Should these or kindred remedies fail, it is best to resort at once to the hypodermic injection of morphia. The recurrence of pain, as the effects of the morphia pass away, can in most cases be prevented by giving to the patient once in four hours from three- to five-drop doses of the fluid extract of gelsemium, suspending its administration so soon as the slightest indication of ptosis is produced. Croton-chloral, in from two- to five-grain doses hourly, has likewise proved effective. Bartholow advises not to push the remedy beyond fifteen grains. Lindner (Arch. f. Gynaek., Bd. xvi, p. 312) recommends ten grains at a dose given at bedtime.

Cephalalgia.—Headache should be treated according to the cause. Constipation should be removed, and iron should be given when the headache is dependent upon anæmia. If of malarial origin, I have never hesitated to give quinine in large doses, and have never yet observed its acting as an oxytocic. When purely of reflex origin, the guarana powder, the diffusible stimulants, and the entire range of nerve sedatives are indicated. Unfortunately, there are no fixed rules by which, in a given case, the appropriate remedy can be invariably selected.

Insomnia.—Troublesome sleeplessness may toward the end of pregnancy reduce a woman to an unfavorable condition for encountering the perils of childbirth. The main reliance should be placed, where possible, upon moderate exercise, upon bromide of potassium, chloral, camphor and hyoscyamus, and codeine. The ordinary forms of opium should be placed under the ban, on account of the fatal facility with which the opium habit is acquired. Even in ordering the less objectionable hypnotics, care should be taken against their continued employment. With proper caution, however, their occasional administration for the purpose of breaking a morbid habit is to be commended.

LABOR.

CHAPTER VII.

THE PHYSIOLOGY OF LABOR AND ITS CLINICAL PHENOMENA.

Causes of labor.—Uterine contractions.—Action of labor-pains upon the uterine walls.—Contraction of ligaments.—Action of abdominal muscles.—Action of vagina.—The pain of labor.—General influence of labor-pains upon the organism.—Precursory symptoms of labor.—First, second, and third stages of labor.—Duration.—Action of the expellent forces.

UNDER the term *labor* are comprised all the physiological and mechanical processes by means of which the extrusion of the ovum from the maternal organs of generation is effected. As the term implies exertion, its application is restricted to the parturient efforts of viviparous animals. The duration of pregnancy varies widely in the different classes of the animal kingdom. The occurrence of normal labor is coincident with the maturity of the fœtus. This, in man, is found to correspond very nearly to the interval between ten menstrual periods.

CAUSES OF LABOR.

Speculation as to the proximate causes of labor has so far proved profitless. The following particulars comprise the extent of our knowledge of the conditions which prepare the way during pregnancy for the final expulsive efforts:

1. During the first three months the growth of the uterus is more rapid than that of the ovum, which is freely movable within the uterine cavity, except at its placental attachment. In the fourth month the reflexa becomes so far adherent to the chorion that it can only be separated by the exertion of some slight degree of force, and the amnion is in contact with the chorion. After the fourth month the chorion and amnion are agglutinated together, though even at the termination of pregnancy they may with care be separated from one another. After the fifth month the agglutination of the decidua vera and reflexa takes place. In the second half of pregnancy the rapid development of the ovum causes a corresponding expansion of the uterine cavity, the uterine walls becoming thinned, so that by the end of gestation they do not exceed upon the average two to three lines in thickness. The vast extension of the uterine surface is not, however,

simply a consequence of over-stretching, a fact shown by the circumstance that the uterus toward the close of gestation is increased from twenty- to thirty-fold in weight, and by the histories of extra-uterine fetations, in which, up to a certain limit, the uterus enlarges progressively, in spite of the non-presence of the ovum. The augmented weight of the uterus is the result of the increase in length and width of the individual muscular fiber-cells, the extreme vascular development, and the abundant formation of connective tissue. Up to the sixth and a half month there has further been observed a genesis of new fiber-cells, especially upon the inner uterine surface. According to Ranvier, the smooth muscular fibers become striated as the end of gestation is reached.*

The precise manner in which the distention of the uterus is accomplished has as yet not been demonstrated. *A priori* only two possibilities are apparently admissible, viz., either the individual structure elements are stretched after the manner of elastic bands, or a rearrangement of the muscular elements takes place in such wise that a certain proportion of the fiber-cells, instead of lying, as in the beginning of pregnancy, parallel to one another, gradually, with the advance of gestation, are displaced, so that the ends only are in juxtaposition. It is probable, though not proved, that toward the close the thinning of the walls is the result of both conditions. Bearing these premises in mind, it becomes a disputed question as to whether one of the causes of labor is not to be found in the reaction of the uterus, as a hollow muscular organ, from the extreme tension to which its fibers are ultimately subjected. Countenance to the affirmative side is afforded by the tendency to premature labor in hydramnion and multiple pregnancies, in which a high degree of tension is reached at a period considerably antedating the complete development of the fœtus.

2. There is a perceptible increase of irritability in the uterus from the very beginning of gestation. Indeed, the occurrence of spontaneous contractions has been put forward by Braxton Hicks as one of the distinguishing signs of pregnancy. This irritability is especially marked at the recurrence of the menstrual epochs; it is very apparent at the beginning of pregnancy, then diminishes in the middle period, and becomes once more a prominent feature in the later months, when spontaneous painless contractions are ordinary incidents of the normal condition.

3. The researches of Friedländer, Kundrat, Engelmann, and Leopold have demonstrated that the decidua vera of pregnancy is distinguishable into an outer, dense, membranous stratum, composed of large cells resembling pavement epithelia, probably metamorphosed cylindrical cells, and an — in appearance — underlying mesh-work,

* *Vide* Tarnier et Chantreuil, Traité de l'art des accouchements, p. 203.

formed from the walls of the enlarged decidual glands. It is in this spongy layer that the separation of the decidua takes place, the fundi of the glands persisting, even after the expulsion of the ovum. By many, a fatty degeneration of the cells of the decidua has been observed toward the end of pregnancy, but Leopold, Dohrn, and Langhans have shown that this is not of constant occurrence.* The trabeculæ which inclose the spaces of the network diminish in size

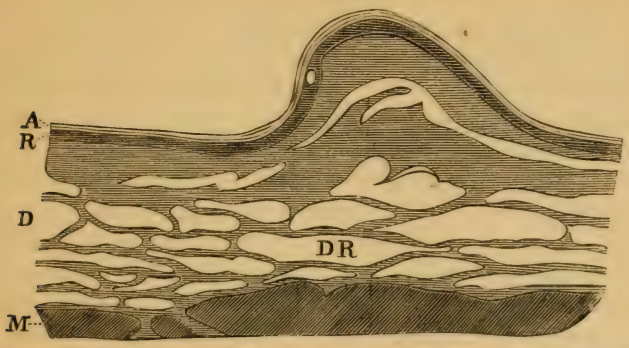


FIG. 61.—The mucous membrane of the uterus. *A*, amnion; *R*, reflexa; *D*, decidua vera; *D. R*, glandular spaces of the lower stratum; *M*, muscular structure of uterus. (Engelmann.)

with the advance of pregnancy. Thus, while they measure at the fourth month about $\frac{1}{100}$ of an inch in thickness, they become gradually reduced in the subsequent months to $\frac{1}{2500}$ of an inch, a change which materially facilitates the peeling off of the decidual surface.†

4. From the fifth month onward, large-sized cells make their appearance in the serotina, especially in the neighborhood of thin-walled vessels. The largest of the so-called giant-cells contain sometimes as many as forty nuclei Though a physiological product, they resemble for the most part the so-called specific cancer-cells of the older writers. They are of special obstetrical interest from the fact observed by Friedländer, and confirmed by Leopold,‡ that they penetrate the uterine sinuses from the eighth month, and lead to coagulation of the blood, and to the formation of young connective tissue, by means of which a portion of the venous sinuses becomes obliterated before labor begins. The subtraction of these vessels from the circulation tends to increase the amount of the venous blood in the intervillous spaces of the placenta.

* LEOPOLD, Studien über die Schleimhaut, etc., Arch. f. Gynæk., Bd xi, p. 49.

† ENGELMANN, The Mucous Membrane of the Uterus, p. 45.

‡ *Op. cit.*, pp. 492 *et seq.* The migration of the giant-cells into the maternal vessels described by Frankenhaeuser has been questioned by Palenko and Heinz, who ascribe the thrombosis of the vessels to proliferation of the endothelial cells, which subsequently become converted into giant-cells. HEINZ, Arch. f. Gynæk, vol. xxxiii, p. 417.

5. It is proper to recall here the fact that the nerve-filaments of the uterus are derived in principal measure from the sympathetic system. The large cervical ganglion, which in pregnancy measures about two inches in length by one and a half inch in breadth, receives, however, in addition to the sympathetic fibers, filaments from the second, third, and fourth sacral nerves.

Physiology has as yet left unsettled the question as to the main channels of the motor impulses which are conveyed to the uterus during labor. One of my hospital patients, with paralysis of the lower extremities, retention of urine, and loss of power over the sphincter-ani muscle, had a perfectly natural though painless labor. The cause of the paralysis was obscure, the patient subsequently making a complete recovery. Jacquemart * reports a similar case, in which the paralysis was due to partial compression of the cord at the level of the first dorsal vertebra. On the other hand, Schlesinger † has shown that the sympathetic is not the only motor nerve, as reflex movements of the uterus follow stimulation of the organ when all the branches of the aortic plexus have been carefully divided.

A motor center for uterine contractions has been proved to exist in the medulla oblongata. This center is excited directly to action by anæmic conditions, and by the presence of carbonic acid in the blood conveyed to it. Vivid mental emotions may either awaken or suspend uterine contractility.

Reflex movements of the uterus may be provoked by stimulating the central end of any of the spinal nerves—a fact which serves to explain the consensus long recognized as existing between the breasts and the organs of generation. When the spinal cord is divided below the medulla oblongata, this phenomenon is no longer observed. Direct stimuli to the uterus, however, determine contractions independently of the medulla oblongata, the spinal cord then acting as a reflex center. The presence of asphyxiated blood in the arterial trunks acts as a physiological stimulus to labor.‡ By the separation of the decidua from its organic connection with the uterus, the ovum acts as a foreign body, and, as is well known, speedily awakens uterine movements. Finally, Kehrer # has shown that, when a cornu is removed from the uterus during labor, rhythmic contractions of the muscular fibers will continue from a half-hour to an hour after separation, provided only the tissues be kept moist and at a suitable temperature.‖

* Tarnier et Chantreuil, Traité de l'art des accouchements, p. 229.

† Ober und Schlesinger, Stricker's Wiener med. Jahrbuch, 1872.

‡ *Vide* Schlesinger, Stricker's Wiener med. Jahrbuch, 1873.

Kehrer, Beiträge zur vergleichende und experimentellen Geburtskunde, 2tes Heft, p. 48.

‖ Cohnstein (Zur Innervation der Gebärmutter, Arch. f. Gynaek., vol. xviii,

The following theory of the causes of labor is offered, not because of its completeness, but merely as a means of grouping the foregoing facts together in the order of their relative importance. The advance of pregnancy is associated with increase in the irritability of the uterus, a property most pronounced at the recurrence of the menstrual epochs. By thinning of the partitions between the glandular structures the way is prepared, as the time for labor approaches, for the easy separation of the dense inner stratum of the decidua. The ready response of the uterus to stimuli reflected from the peripheral extremities of the spinal nerves, to direct local irritation, and to the presence of blood surcharged with carbonic acid in the uterine vessels, explains the frequency of painless contractions for days, or even weeks, in some cases, previous to labor. To these means of exciting uterine motility there should be added, in all probability, the reaction of the uterine muscle, from the tension to which it is subjected by the growth of the ovum, and to circulatory disturbances in the cerebral centers sometimes effected by vivid emotions. Frequently repeated uterine contractions, without partial separation of the decidua, are hardly comprehensible after the decidua vera and reflexa are brought into close contact with one another. Such a physiological separation would of necessity, when of sufficient extent, by converting the ovum into a foreign body, furnish an active cause for the advent of labor, in the same way that labor is prematurely excited by a similar separation when artificially induced. Thus, by the time the development of the fœtus is completed, all things are in train for its expulsion. When other causes do not early operate as determining forces, the increase of uterine irritability at the recurrence of the menstrual epochs probably accounts for the ordinary coincidence of labor with the tenth catamenial date.

Physiological Phenomena of Labor.

The Uterine Contractions.—The uterine contractions are entirely independent of volition. As in other organs composed of smooth muscular fibers, each contraction at the beginning is slow and weak; gradually it reaches the point of greatest intensity; the acme continues for a brief period, and then, finally, is followed by complete relaxation. Each complete excursion is termed a labor-pain. Peristaltic movements have been observed in animals with two-horned uteri. A similar action, proceeding from the fundus to the cervix, has been sometimes assumed for the human subject. The peristaltic wave, however, if indeed it exists, extends so rapidly that it is best to consider the uterus as a hollow muscle, which contracts simulta-

p. 394), from his own experiments and those of others, concludes that the determining cause of the uterine contractions is contained in the intra-muscular ganglionic cells; that the central nerve-organs regulate the uterine activity, and that the sympathetic acts simply as a vaso-motor nerve.

neously in all its parts. As labor advances, an increase in the length and the force of the contractions is developed. The stronger the pains, the shorter is the interval between them. The average normal duration of a labor-pain is about one minute.

The Action of Labor-Pains upon the Uterine Walls.—During the intervals between the pains, it is well known that the uterus possesses

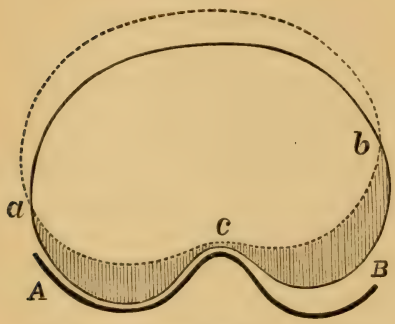


FIG. 62.—Transverse section, dotted line representing shape of uterus during a pain. (Lahs.)

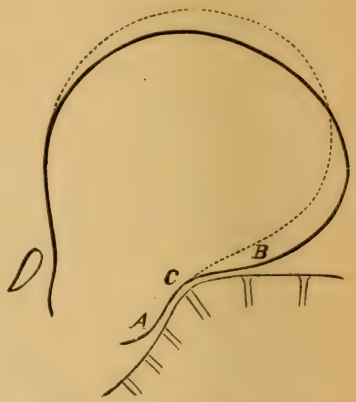


FIG. 63.—Longitudinal section, dotted line representing elevation of fundus during a pain. (Lahs.)

an ovoid shape, and is flattened antero-posteriorly by the pressure of the abdominal walls. During the pains, however, the uterus, as it closes upon the fluid contents of the ovum, assumes a more nearly globular outline. As a consequence, the transverse diameter is diminished, and the antero-posterior increased in corresponding proportion. By this change, the uterus, which had previously rested by its posterior surface upon the spinal column, rises upward so that its fundus produces a bulging of the anterior abdominal walls.

Owing to the loose connection of the muscular strata with the peritonæum in the lower uterine segment, the walls of the latter offer less resistance to the pressure of the ovum, and thus are stretched downward during each pain. While, in contractions of the uterus, the lower segment is thinned, the diminished bulk of the contracted organ leads to an increase in the thickness of the walls of the body and fundus.*

The Contractions of the Uterine Ligaments.—Structurally the muscular fibers of the round and broad ligaments are in direct continuity with the external muscular layer of the uterus. As would be anticipated, they contract simultaneously with that organ. In contracting, they help to fix the uterus at the pelvic brim.

* For most of the following deductions the writer is indebted to Dr. LAHS's ingenious work entitled Die Theorie der Geburt. For modifications in details in the present edition, *vide inter alios* WERTH, Die Physiologie der Geburt, MÜLLER'S Handbuch der Geburtshülfe, vol. i, p. 330.

The Action of the Abdominal Muscles.—The contraction of the abdominal walls is a powerful auxiliary to the expulsive action of the uterus. At the beginning of labor the contractions are voluntary, but as labor advances they become more and more reflex in character, until, in many women, the disposition to press during each pain assumes the form of an uncontrollable impulse. The mechanism by which these auxiliary forces are called into play is as follows: As, toward the acme of the pain, the fundus uteri is elevated and lifts up the abdominal walls, the woman takes a deep inspiration, the glottis closes, and the diaphragm contracts. The latter pushes the intestines downward, and thus aids in raising the uterus to a position nearly perpendicular to the pelvic brim. All the expiratory muscles then enter into active contraction. Meantime, the laboring woman secures fixation of the trunk by finding points of support for the upper and lower extremities. By these means the capacity of the abdominal cavity is greatly diminished, and the uterus is compressed not only by the adjacent muscular coverings, but by the entire mass of inclosed viscera. The effect is twofold:

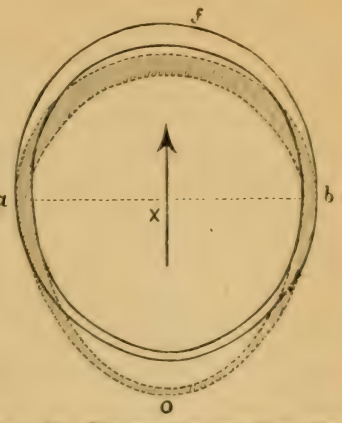


FIG. 64.—Diagram representing the changes in the thickness of the uterine walls during labor. (Labs.)

1. There results an augmentation of the intra-uterine pressure.

2. A portion of the contents of the large vessels of the trunk is forced to the extremities. To this cause is attributable the flushed, congested appearance of the face during labor-pains. As the intra-abdominal pressure is not brought to bear upon the organs within the pelvic cavity, hyperæmia of the vagina and the contiguous tissues follows. As a consequence, the channel through which the head has to pass, as labor advances, becomes infiltrated with serum, and offers less resistance to the presenting part. At the same time the glandular structures are excited to increased action, and the lining mucous membrane becomes lubricated by the secretion which is freely poured out.

The Influence of the Vagina in Parturition.—As the head advances through the cervix, the vagina at first opposes an obstacle to its further progress. After, however, the largest circumference of the child has passed through the genital canal, the contractions of the vagina aid somewhat in the expulsion of the after-coming extremities and of the placenta.

The Pains of Labor.—The painful sensations which are the accom-

paniment of the uterine contractions begin in the lower uterine segment. They are at first especially felt over the sacrum, whence they radiate to the rectum and the bladder, across the abdomen, and down the thighs. In the beginning of labor the sensations are dull, and of a bearing-down character. As labor advances, however, the pains increase in acuteness, and in many persons reach an unendurable degree of severity. They are mainly induced through the compression of the uterine nerves by the contractions of the muscular fibers. They are probably likewise in part the result, as Werth suggests, of hyperæmia of the lower extremity of the spinal cord and of its envelopes. The severity of the pains is proportioned to the resistance to be overcome. At first, as has been stated, confined to the lower segment of the uterus, the pains subsequently invade the body and the fundus. The sufferings of the female increase with the mechanical distention of the cervix, especially with that of the external orifice, and finally reach the point of supreme agony as the head passes through the vagina and vulva, which are abundantly supplied with sensitive spinal nerves.

The pains are often greater in very young or in elderly primiparæ than in women at the prime of physical life. Though labor is rarely absolutely painless, where the first stage is slow and the resistance of the soft parts slight the suffering may become comparatively insignificant.

Influence of the Pains upon the Organism.—During each pain the arterial pressure is increased; the frequency of the pulse rises until the acme is reached, when it slowly declines to the normal point; the respirations are slowed during the pains, owing to the contraction of the abdominal walls, but are more rapid in the pauses as a consequence of the general muscular exertion; the temperature rises progressively during labor, but, as a rule, within narrow limits; and the urinary excretion, in consequence of the increased arterial pressure, is augmented.*

The Clinical Course of Labor.

Precursory Symptoms.—About the thirty-ninth week of pregnancy it is usual for the entire uterus to sink somewhat downward into the pelvis, while the fundus falls forward. This change of position is followed by considerable relief to the respiration, and to previously existing gastric disturbances. At the same time there is experienced an increased difficulty in locomotion; the œdema of the lower extremities is aggravated; the intra-pelvic pressure causes a frequent desire to urinate, and predisposes to the development of hæmorrhoids, especially where, as is the rule in primiparæ, the head likewise descends deep into the pelvic cavity. Indeed, in primiparæ the changes of

* Naegele, Lehrbuch der Geb., p. 163.

position are more pronounced than in women who have passed through repeated pregnancies. As gestation draws to a close, a copious glairy secretion is poured out from the cervix, the vagina relaxes, the labia majora become swollen, and the vulva gapes open. For a variable period preceding the advent of labor, painless contractions occur at irregular intervals. These so-called *dolores presagientes* are the ordinary prelude to labor in multiparæ, though they are often inappreciable in primiparæ. They very commonly begin in the evening hours and continue till toward the middle of the night. Very often they are associated with a dragging sensation between the sacrum and symphysis and a feeling of tension in the abdominal region. Sometimes they expand the os internum to a considerable extent, but never in such a way that any portion of the cervical canal contributes to the enlargement of the uterine cavity.

Actual labor has been divided, as a matter of clinical convenience, into three stages, as follows:

First stage, or stage of dilatation of the cervical canal.

Second stage, or the stage of expulsion, comprising the period from the dilatation of the cervix to the expulsion of the child.

Third stage, or stage of the placental delivery.

1. The First Stage—Dilatation of the Cervix.—The advent of true labor is characterized by painful contractions, which render the patient restless, and dispose her either to bend forward with clinched hands, or to seek some firm support for the sacrum to ease her sufferings. Usually, in the beginning of labor, women prefer the sitting posture, which enables them to press with the forearm against the sacrum during the pains. The pain of labor begins with the dilatation of the internal os. In true labor the dilatation progresses gradually. As the os internum opens, the contractions cause the membranes to descend and press upon the cervical canal. With the advance of labor the pains increase in intensity and frequency. During their persistence the external os is put upon the stretch, so that the border becomes thin and sharply defined.* As the pain subsides, the os relaxes and the membranes retreat. Each new pain increases the dilatation, and forces the membranes somewhat deeper. The softening, the relaxation, and the hypersecretion of the soft parts become more and more decided. As the borders of the os yield to pressure, lacerations occur, which tinge the mucous discharges with blood. When the dilatation has reached a certain limit (usually by the time the diameter of the external os is three to three and a half inches), the protruding membranes remain tense in the intervals between the pains, and are then ready for rupture. After rupture, which usually occurs spontaneously, the water in front of the child's head escapes, though the greater part

* In multiparæ this resistance of the external os may be entirely lacking.

of the amniotic fluid is retained within the uterus by the valve-like pressure of the presenting part. After a short pause the head descends into the cervix, the walls of which are stretched to the pelvic borders,

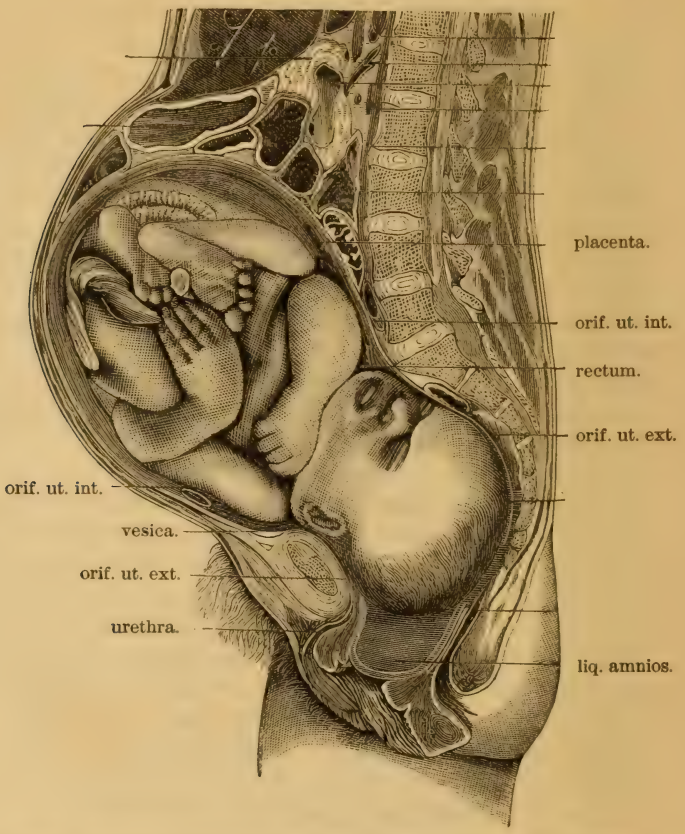


Fig. 65.—Section through a frozen corpse. Stage of expulsion. (Braune.)

and finally become so dilated that cervix and vagina form one continuous canal.

In case the presenting part does not thoroughly tampon the lower segment of the uterus, a more or less complete escape of the entire amniotic fluid may follow the rupture of the membranes. As a rule, the tear in the membranes takes place in the most dependent point of the convex portion which constitutes the bag of waters in the cervical canal. Sometimes, however, the rupture takes place above the cervix, where there can be a gradual escape of fluid in spite of the persistence of the bag of waters.

If the membranes rupture before the dilatation of the cervix is complete, the head descends and acts as a dilating wedge. In rare

cases the rupture of the membranes, if left to nature, does not occur, and the ovum may descend in its integrity to the vulva. In such instances the membranes sometimes rupture in the neighborhood of the

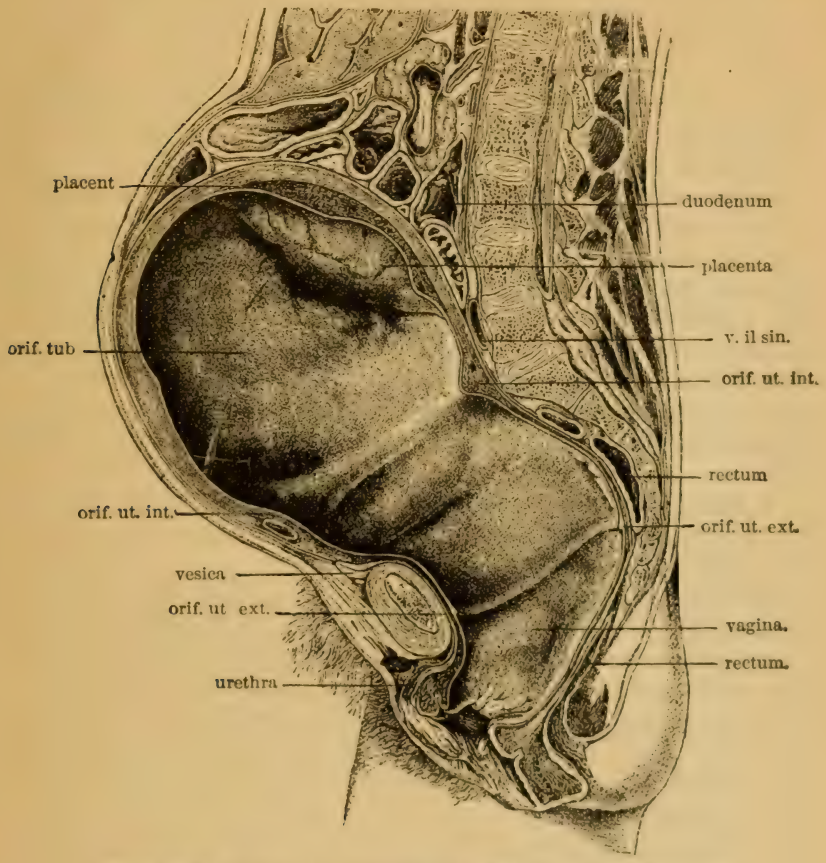


FIG. 66.—The uterus and parturient canal. Fœtus removed. (Braune.)

child's neck, and the head is born covered with the so-called "caul," i. e., with the detached portion of the membranes, which old nurses regard as significant of good luck. In still rarer cases, where the fœtus is small and the amount of amniotic fluid limited, the entire ovum may be expelled without rupture of its coverings.

2. The Second Stage—The Stage of Expulsion.—After the short pause which follows the rupture of the membranes, the pains become stronger and more frequent, and are now powerfully re-enforced by the involuntary contractions of the abdominal muscles, which, though previously not entirely inactive, have played only a subordinate part. With each pain the head now makes perceptible progress, retreating, however,

as the pains decline. After the head has passed the pelvic outlet, and is covered only by the soft parts, the perinæum bulges outward, the labia gape, and a portion of the head makes its appearance at the vulva. As within the pelvic canal, with each pain the head advances, and puts the perinæum upon the stretch, receding somewhat in turn as the pains subside. The pressure upon the rectum leads to the evacuation of fecal contents. Finally, the thinning of the perinæum reaches a point at which the sutures can be readily felt through its structure; the recession of the head ceases; the anus assumes an oval shape; the orifice of the vulva looks forward and upward; the urethra is pushed against the symphysis pubis; while, as the circumference of the head in the neighborhood of the parietal bosses engages in the vulva, the labia and frænulum form a thin circular band, through which, during a pain or the contraction of the abdominal walls, the head makes its way, usually leaving behind moderate lacerations of the frænulum or anterior portion of the perinæum. The same, or the succeeding pain, leads to the expulsion of the trunk. The birth of the child is followed by the outpouring of the amniotic fluid, which, as a rule, escapes colored with blood from the site of the wholly or partially detached placenta.

3. The Third Stage—The Stage of the Placenta.—The placental period embraces the time from the birth of the child to the delivery of the placenta and membranes.

After the birth of the child, the recession of the blood from the brain, which follows the diminution of the intra-abdominal pressure, often produces a sense of faintness, and sometimes temporary syncope. The rapid evacuation of the uterus is at times, too, succeeded by a chill, which, however, does not betoken the onset of fever, but is the result of vaso-motor disturbance, and the loss, through the expulsion of the child, of a source of heat-supply. Most women, however, experience a restful feeling of comfort and repose. This sense of quietude lasts anywhere from a few minutes to a quarter of an hour, when the contractions return, which detach the placenta, and force it into the vagina. The separation of the placenta takes place in the meshy, lamellated layer which is formed in the serotina by the thinned, elongated walls of the gland-tubules, the dense cell-layer of the maternal portion remaining adherent to the placenta. As the maternal vessels are necessarily torn across, some hæmorrhage follows the detachment. The hæmorrhage is, however, speedily arrested by the contractions of the uterus, which both compress the vessels and furnish the conditions favorable to the formation of fibrinous clots in their distal extremities. When the mechanism of expulsion is left to nature, the placenta descends by its edge into the vagina, while premature tractions upon the cord cause it to present by its fetal surface at the cervical orifice. When once in the vagina, the expulsion is completed by the action of

the abdominal muscles, sustained by the retraction of the muscles which form the floor of the pelvis.

According to Gassner,* after confinement the female experiences, as a consequence of the expulsion of the ovum, of the exhalations from the lungs and skin, from the discharge of excrements, and from hæmorrhage, a loss of weight equivalent to one ninth of that of the entire body.

Duration of Labor.—Spiegelberg found, in 506 labors, the average for primiparæ was 17 hours, for multiparæ 12 hours. In primiparæ past the thirtieth year Hecker found the average 21·1 hours, while Ahlfeld, in 82 women over thirty-two years of age, obtained an average of 27.6 hours.†

In ordinary normal labor the second stage lasts about two hours in primiparæ, and about half as long in multiparæ, though in the latter the resistance is frequently so slight that a few pains suffice to complete the delivery.

According to Kleinwächter,‡ the time at which labor-pains begin occurs most frequently between ten and twelve o'clock in the evening. Spiegelberg# states that the maximum frequency of births takes place between twelve and three o'clock in the morning.

The Action of the Expellent Forces.

Having considered separately the action of the uterus, the uterine appendages, and the abdominal muscles during labor, there remains for us to combine these factors together, and to show in what manner they contribute to the end of all parturient effort, viz., the expulsion of the ovum.

In the first place, the contractions of the uterus are intermittent. When they lose their rhythmical quality and become continuous, they cease to belong to the domain of physiology. It is only during the act of contraction that work is performed. Whenever the alternating relaxation ceases, and the uterus passes into a condition of tonic contraction, no work is accomplished, and the pains are ineffective.

The uterus is a hollow muscle, which during a pain closes down upon its contents. If all parts of the uterine walls offered an equal resistance, the force of the contractions would be expended upon the periphery of the ovum, and, as the contents of the latter are practically incompressible, the effort would be resultless. If, however, the walls were so constructed that the distensibility varied in different regions,

* Gassner, Ueber d. Veränderungen des Körpergewichtes b. Schwang., Gebär. und Wöchner, Monatsschr. f. Geburtsk., xix, p. 18.

† Spiegelberg, Lehrbuch, pp. 134, 135.

‡ Kleinwächter, Die Zeit des Geburtsbeginnes, Ztschr. f. Geburtsh., Bd. i, p. 230.

Spiegelberg, Lehrbuch, etc., p. 135.

the peripheral compression exerted during a pain would be followed by a bulging at the points of least resistance, provided the tissue acted upon possessed the property of elasticity. Now it is an anatomical fact, that during a labor-pain a stretching of the fundus and of the lower uterine segment actually takes place. Indeed, after continued labor we often find the intermediate portion of the uterus two to three times as thick as the lower segment. As a result of these conditions, concentric pressure of the fluid contents of the ovum is followed by an increase in the longitudinal diameter of the uterus. While the convexity of the fundus is unquestionably increased during a pain, the effect of the latter is chiefly manifested in the distention of the lower segment. Various causes combine to produce this result. Thus, the muscular structures of the lower segment are loosely associated together, and are easily separable from the peritonæum. They therefore offer a less resistance than that afforded by the close interlacement of both circular and longitudinal fibers which prevails in the fundal and upper uterine zones. Then, too, as was pointed out by Lahs,* the lower segment sustains, in the ordinary positions assumed by the female, the entire weight of the superimposed ovum with its fluid and solid contents; and, finally, the pressure transmitted from the abdominal muscles takes a direction from above downward.

In 1876 Bandl † called attention to the thinned condition of the lower uterine segment, extending from what had been previously regarded as the os internum from four to six inches upward, and terminating abruptly in a muscular ridge upon the inner surface. This ridge he regarded as the upper limit of the cervical canal, which had been opened up by the growth of the ovum. Lahs ‡ however, places this ring at the level of the pelvic brim. Above the pelvic brim, he says, the convexity of the uterus is nearly uniform, while the portion of the uterus below forms, as it were, a segment of a sphere with a short radius attached to the abdominal division. In this way, upon longitudinal section, a projection of the wall toward the uterine cavity is observable at the pelvic brim where the two segments meet. He therefore proposes that the ridge thus produced be called the "pelvic-brim stricture." My own observations, which correspond to those of Schroeder, show that in many instances this ridge is but slightly indicated before the beginning of labor. During and as a consequence of the labor-pains, the ridge becomes well marked, and clearly defines the limits between the thinned, stretched lower portion and the thickened, retracted upper portion of the uterus. Both from a physiological and a pathological point of view this limiting ring possesses great import-

* Lahs, Die Theorie der Geburt, p. 116.

† Bandl, Ueber das Verhalten des Uterus und Cervix in der Schwangerschaft und während der Geburt.

‡ Lahs, Was heisst Unteres Uterinsegment, Arch. f. Gynaek., vol. xxiii, p. 215.

ance. It is desirable, therefore, that it receive a designation definitive of its character. The term "ring of Bandl," which has received some currency, is objectionable, because that term has already become associated with Bandl's views as to the true position of the internal os. The "pelvic-brim stricture" of Lahs has an awkward sound in English, and expresses a theory not yet absolutely established. Ebell proposed the name "mechanical or clinical os," but it requires a complete familiarity with the discussion which the subject has occasioned not to confound the structure with the orifices of the cervical canal. My own choice would be to term it the "retraction ring," as indicative of what I believe to be its origin. As, however, Schroeder has already introduced the term "contraction ring," and as that term has become somewhat familiar, I have thought it best to accept that designation in these pages in spite of criticisms which have been made as regards its propriety.

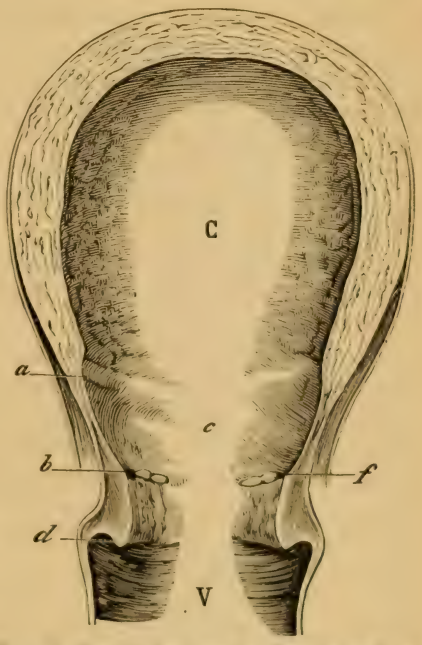


FIG. 67.—Longitudinal section through walls of uterus in eighth month of pregnancy (Bandl). *a*, contraction ring, or ring of Bandl; *b*, os internum; *d*, os externum.

So far, for the sake of simplicity, we have regarded the uterus as a closed sac, possessing walls of unequal thickness. In reality the lower segment terminates in an opening, the canal of the cervix, which, though at the beginning of labor of small size, and offering considerable resistance to the pressure of the ovum, is capable of sufficient distention to permit the exit of the fœtus.

The dilatation of the cervix is partly mechanical, and partly the effect of certain organic changes which have already received cursory mention.

The mechanical dilatation is the result of—1. The pressure of the ovum upon the lower uterine segment, which forces open the os internum, and unfolds the cervix from above downward.

2. The retraction of the uterus is an important property, which requires brief description. While each contraction of the uterus is followed by relaxation and a period of repose, a gradual change is continually going on in the length and arrangement of the muscular fibers. In the thinned lower segment the fibers are stretched, and

separated from one another. In the upper portion, on the contrary, they shorten, and change their position in such a way that those which previously had only their extremities in contact assume a more nearly parallel arrangement. The walls, therefore, in the upper zones thicken and shorten, especially in the longitudinal direction. The limit between the thinned lower segment and the upper thickened zones is marked, as we have seen, by a distinct ridge termed by Schroeder the contraction ring. It is to the changes in the uterus which take place above the contraction ring that the term retraction is applicable. As the retraction is progressive, it leads to a gradual withdrawal upward of the uterine walls, in consequence of which the lower segment is not only put upon the stretch during the pains, but toward the end of the period of dilatation is subjected to a greater or less degree of permanent tension. Then, too, as the contraction ring moves upward, a phenomenon observable where the descent of the head is hindered, the longitudinal fibers of the lower segment, by reason of their insertion in part at least into the vaginal portion, exert a direct influence in dilating the cervical canal.

3. When the abdominal muscles contract, the uterus is pressed downward into the pelvic cavity. The descent is, however, limited by the attachment of the uterine ligaments and the adjacent organs. But the resistance afforded by the uterine attachments exercises a peripheral traction upon the cervix, and thus tends to draw its walls asunder.

The normal dilatation of the cervix is, however, by no means a matter of pure mechanical distention. If the canal which forms the communication between the vagina and the uterus were simply an elastic tube, it would of necessity retract down upon the neck of the fœtus after the passage of the head, and thus a new distention would be required to permit the passage of the shoulders. Indeed, the conditions of an elastic tube are not unfrequently realized in versions, where an attempt is made to extract the fœtus through an imperfectly dilated os; in which case, after the disengagement of the shoulders, the cervix is apt to close upon the neck and arrest the delivery of the after-coming head. That this complication does not happen as a rule, is due to the fact that in natural labors the mechanical expansion is associated with certain organic changes, which render the cervix soft and distensible and at the same time diminish its retractility. The basis of the organic changes consists in the serous infiltration of the lymphatic interspaces, which separates the tissue-elements, and deprives them of the resistance afforded by the force of cohesion. The main factor in the production of the softening of the cervix is an active hyperæmia, which the cervix shares during pregnancy with all the pelvic organs, and which during labor is greatly enhanced by the diminished pressure to which the parts below the pelvic brim are subjected. We have already noticed how, during the acme of a pain,

the contents of the uterine vessels are forced into the vessels of the intra-pelvic viscera.

In normal head presentations the organic changes are in a special degree furthered by the formation of what is known as the bag of waters. As the head descends into the lower uterine segment, the contraction of the muscular fibers around its largest circumference separates a layer of fluid from the contents of the uterine cavity. At first this layer becomes tense only during a pain. With the descent of the head the tension increases, and the "bag of waters" is formed. As the abdominal pressure is not operative below the pelvic line, and as the intra-uterine pressure is arrested in a measure by the child's head, in that portion of the uterus which lies below the circle of cephalic compression, hyperæmia, serous infiltration, and softening follow as necessary corollaries of the anatomical conditions. The value of the bag of waters in dilating the cervix is due, therefore, not only to the hydrostatic pressure it exerts, but to the manner in which it favors the development of the organic processes described.

Thus far we have considered the expellent forces as acting upon the ovum as a whole. Many authorities accept in addition a direct pressure of the fundus upon the breech of the child, which is transmitted through the spinal column to the cephalic pole. A little reflection, however, will show, as Lahs* has pointed out, that so long as the ovum contains any measurable quantity of fluid, or at least more than enough to fill the fetal interspaces, the immediate contact of the breech with the fundus is hardly possible. To be sure, Ahlfeld† determined, by direct measurements, that there was an actual increase of about one and a half inch in the distance between the two poles of the child in head-presentations during the height of a pain. Schroeder‡ attributes this extension to the lateral compression of the fœtus, which results from the diminution of the transverse diameter of the uterus during contraction; but it is evident that lateral pressure would equally produce an elevation of the fluid contents of the ovum, and thus, as the fundus assumes a spherical shape, prevent the impingement of the breech. Moreover, it is not easy to see how, so long as the fœtus is surrounded by a fluid medium, any effective propulsive force can be transmitted through a flexible column like the spine. It is certain that, in the intervals of the pains, manual pressure upon the breech through the fundus simply bends the fetal body, and deflects it from the vertical direction. Even if, during a pain, the lessening of the uterus in the transverse diameter hinders this movement to some extent, the increase antero-posteriorly would still leave ample space for lateral incurvation.

* Lahs, Studien zur Geburtskunde, Arch. f. Gynæk., Bd. iii, p. 195.

† Ahlfeld, Arch. f. Gynæk., Bd. ii, p. 367.

‡ Schroeder, Lehrbuch der Geburtshülfe, 6te Aufl., p. 156.

The descent of the ovum is followed necessarily by increased tension of the bag of waters. Under a pressure, estimated by Duncan * as varying, according to the resistance of the membranes, between four † and thirty-seven and a half pounds, rupture occurs. The cervix then usually closes, but remains dilatable; i. e., it yields readily to pressure, and offers no resistance to the advancing head.

The pressure exerted by the united action of the uterine and abdominal walls requisite to accomplish delivery, according to the estimates of Schatz,‡ based upon manometric observations, varies between seventeen and fifty-five pounds.# Although the methods by which both the results of Schatz and Duncan have been obtained possess defects, which the authors themselves make no attempts to conceal, they are quoted as furnishing approximations to the truth.

CHAPTER VIII.

MECHANISM OF LABOR.

Anatomical factors.—Anatomy of pelvis.—Sacrum.—Coccyx.—Ossa innominata.—The ilia.—The pubes.—The ischia.—Articulations of the pelvis.—Sacro-iliac articulations.—Symphysis pubis.—The pelvic ligaments.—Obturator membrane.—Sacro-sciatic ligaments.—Inclination of the pelvis.—The pelvis as a whole.—The pelvic planes.—Plane of the brim.—Plane of the outlet.—Planes of the cavity.—Ischial planes.—Pelvic axis.—Differences between male and female pelvis.—Differences between the infantile and adult pelvis.—The soft parts of the pelvis.—The perineal floor.—The head of the fœtus at term.—Sutures and fontanelles.—The diameters of the fetal head.—The articulation of the head with the spinal column.

THE mechanism of labor comprehends the movements of adjustment, by means of which the fœtus accommodates itself to the dimensions of the bony pelvis and to the variations in the direction of the parturient canal. Its study is, therefore, properly prefaced by the enumeration of a series of anatomical details relating to the pelvic ring and the soft tissues which form the floor of the pelvic basin, and to the structure, the diameters, and the reducibility of the fetal head.

* DUNCAN, Researches in Obstetrics.

† RIBÉMONT, Recherches expérimentales sur la résistance, etc., des membranes de l'œuf humain, p. 35, places the minimum resistance at fifteen and three fourths pounds.

‡ *Vide* SCHROEDER, Lehrbuch, 6te Aufl., p. 158.

POLAILLON, Recherches sur la physiologie de l'utérus gravide, p. 38, estimates the minimum pressure at twenty-three pounds.

The Anatomy of the Pelvis.

The following description includes only such points as are of direct obstetrical interest:

The bony pelvis is formed by the union of the sacrum and coccyx and the two ossa innominata.

The Sacrum.—The sacrum is a curved quadrilateral bone, inserted like a wedge between the ossa innominata. Like a wedge, it is broad above and tapers toward its lower extremity. It is composed of a central vertebral portion, and two outer masses termed the alæ or wings. The central portion, as its name implies, is really a continuation of the spinal column. In early childhood it consists of five distinct vertebræ with well-defined joint-surfaces and intermediate cartilaginous

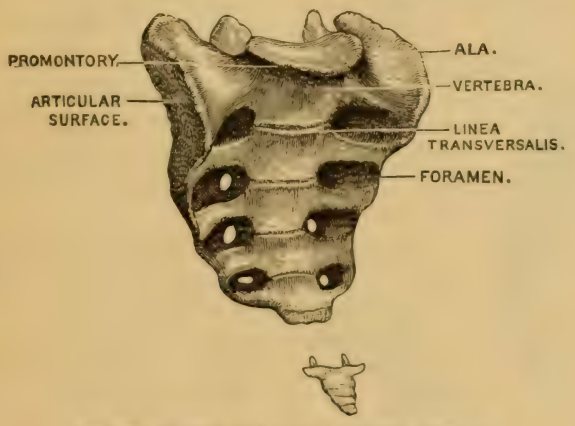


Fig. 68.—Sacrum and coccyx (anterior surface).

disks; but with the completion of the growth the whole becomes consolidated into a single piece by the inter-articular deposition of bone. The bony union is confined chiefly to the outer circumference, and is marked by ridges termed the *lineæ transversæ*. The base of the sacrum articulates with the last lumbar vertebra, with which it forms a projecting angle. It possesses a convex anterior surface, termed the promontory, which juts forward and encroaches upon the pelvic space.

From the sides of the central piece there extend two triangular portions of bone, termed the alæ or wings. Under normal conditions they are symmetrical. They are developed upon each side from three independent nuclei, which make their appearance near the bodies of the three upper vertebræ. They are supposed to have the morphological significance of ribs. In the course of this growth they fuse together, except at the points of junction of the bodies of the vertebræ, where they leave between them open spaces or foramina, for the passage of the spinal nerves.

The sacrum in the female is about four and a half inches wide, and from four to four and a half inches long, when measured from the promontory to the lower extremity. The sacrum possesses two curves: one, less marked, from side to side, and the other extending from above downward. The depth of the latter is greatest just below the upper border of the third vertebra, where it measures a little over an inch.

Upon the posterior surface we notice a canal, continuous with the spinal canal, which runs the entire length of the sacrum, but is incompletely closed at the fifth vertebra, giving rise to a slit-like opening, termed the *hiatus sacralis*. In the middle line the spinous processes coalesce into a vertical crest for the attachment of the erector spinæ muscle. The posterior lateral masses are formed by the fusion of the transverse processes and their consolidation with the anterior structures. Next to the vertebræ, however, spaces are left between the processes for the passage of the posterior sacral nerves. Opposite the three upper vertebræ, the outer border is known as the tuberosity of the sacrum. It possesses a roughened surface, to which are attached the sacro-iliac ligaments.

FIG. 69.—Section of sacrum and coccyx.

The upper portion of the side of the sacrum is furnished with an ear-shaped articulating surface termed the *superficies auricularis*.

The Coccyx.—The coccyx is composed of four rudimentary vertebræ, which progressively diminish in size from above downward. It possesses as a whole, therefore, a triangular shape. It is attached to the extremity of the sacrum by a hinge-joint, and is pushed backward during defecation, and in childbirth as the head passes the pelvic outlet. It is only when anylchosed that the coccyx assumes obstetrical importance.

The Ossa Innominata.—Each os innominatum may be roughly compared to a figure eight, of which the upper and larger portion slants upward, outward, and backward, while the lower smaller division inclines downward and inward. Up to the age of puberty it consists really of three bones, which are connected at the acetabulum by cartilage of a Y-shape. These three bones are termed respectively the ilium, the ischium, and the pubes, names which are subsequently retained for convenience of description, in spite of the fact that in adult life the separate parts become solidly united, by the deposition of bone-tissue, into a single continuous piece.

The iliac portion has an external surface marked by a number of roughened lines, to which are attached the three gluteal muscles. The inner surface is excavated and forms the so-called iliac fossa, which

contains the internal iliac muscle. The fossa is bounded below by the linea arcuata interna, a convex ridge which contributes to form the

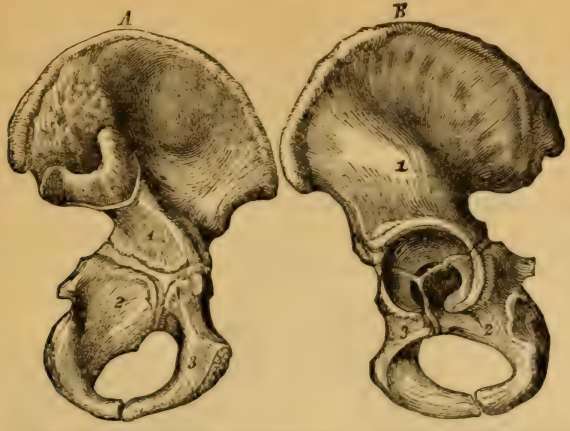


FIG. 70.—Os innominatum, before consolidation. 1, ilium ; 2, ischium ; 3, pubes.

brim of the pelvis. The upper border or crest of the ilium possesses an S-shaped curve, the anterior extremities of which are directed in-

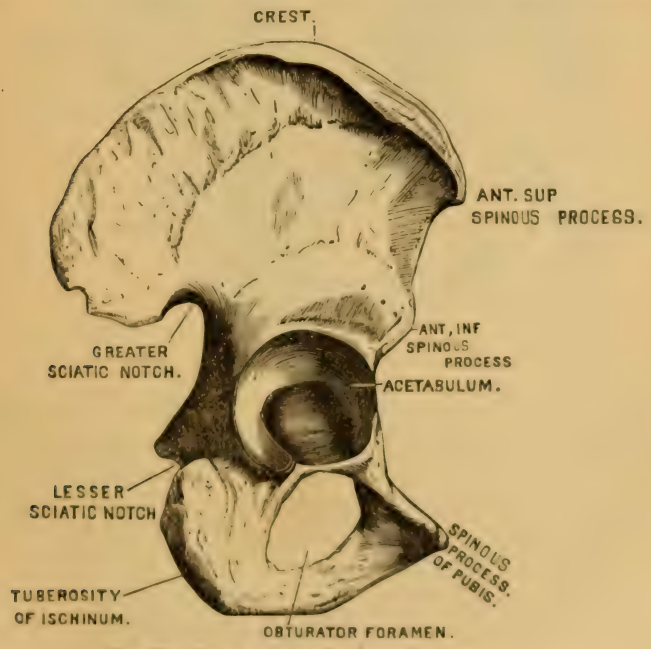


FIG. 71.—Outer surface of os innominatum.

ward. The crest of the ilium terminates, front and rear, in bony prominences, termed respectively the anterior and posterior superior

spinous processes. Beneath the upper spines, and separated from them by curved indentations, are two lower, less sharply defined projections, termed the anterior and posterior inferior spinous processes. Behind the iliac fossa is situated an ear-shaped articular surface, the superficies auricularis, which corresponds to the surface of similar name described upon the sides of the sacrum.

The pubic portion consists of the body and two rami. The body presents upon its inner border an oval surface, which articulates with the pubic bone upon the opposite side. The superior border is furnished with a rough crest, terminating in the projecting spine. The upper, or, as it is usually designated, the horizontal ramus, possesses a ridge, the pecten pubis, extending from the spine and becoming con-

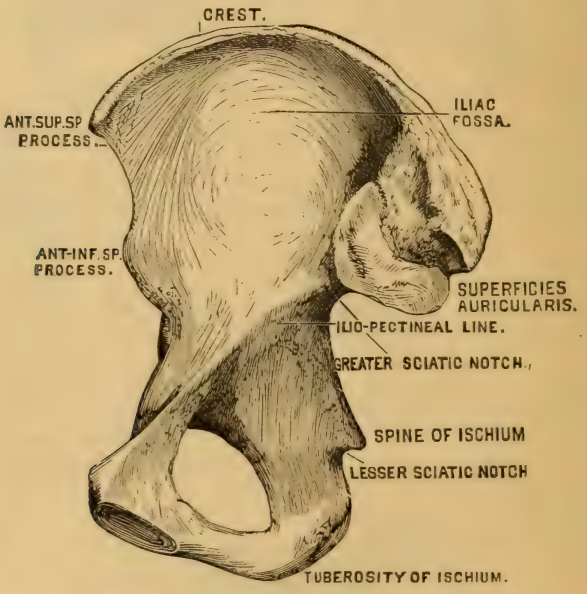


Fig. 72.—Inner surface of os innominatum.

tinuous with the linea arcuata of the ilium. The linea terminalis, or boundary-line of the pelvic brim, is generally known as the ilio-pectineal line, from its sources of origin. Near the junction of the ilium and os pubis is situated a slight elevation, the ilio-pectineal eminence, which, however, according to Luschka,* belongs entirely to the pubic bone. The descending ramus helps to bound the obturator foramen, and to form the pubic arch. The ischium completes the lower portion of the os innominatum. It consists of two rami, which, with the rami of the pubic bones, include the obturator foramen. It contributes about two fifths to the formation of the acetabulum; from this the descend-

* Luschka, Die Antomie des menschlichen Beckens, p. 86.

ing ramus drops vertically downward, and thence curves forward, and forms the ascending ramus, which unites with the descending ramus of the pubes. At the point where the descending ramus hooks forward there is a thickened projection, termed the tuberosity of the ischium, upon which the body rest in the sitting posture. Upon the posterior border of the descending ramus there is a sharp spine, projecting inward, which plays an important part in the mechanism of labor. Between the posterior inferior spinous process and the spine of the ischium there is a deep incurvation, termed the great sciatic notch; while a smaller incurvation, between the spine and the tuberosity, is known as the small sciatic notch.

The Pelvic Articulations.—The articulations of the ossa innominata with the sacrum are usually termed the sacro-iliac synchondroses. The

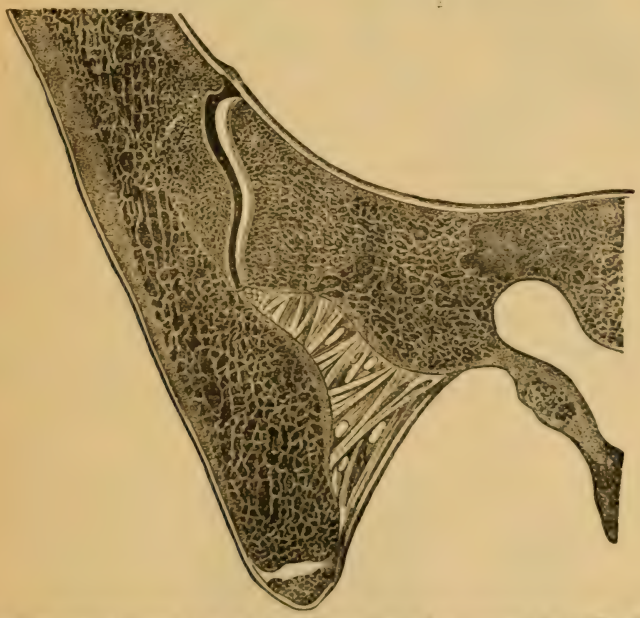


FIG. 73.—Section through the left sacro-iliac articulation (natural size). (Luschka.)

anterior articulation of the innominate bones with one another is known as the symphysis pubis.

The term "synchondrosis," as applied to the sacro-iliac articulation, is really a misnomer. Luschka has shown that, in place of an intervening plate of cartilage, section demonstrates the existence of a true synovial membrane, limiting a narrow but well-defined joint-cavity. The middle third of the iliac surface is convex, and fits into a corresponding concave depression on the sacral end. There is likewise a "bite" or ledge in front, formed by the ilium, which aids in preventing the sacrum from slipping forward into the pelvic cavity.

The office of maintaining the sacrum in position devolves chiefly upon the ligaments distributed front and rear, and particularly upon the very numerous and closely interwoven bundles extending from the tuberosities of the sacrum to the roughened portions, or tuberosities, of the ilia, which project posteriorly beyond the articulation.

The symphysis pubis is likewise supplied with a small cavity, only the posterior portion of which possesses a synovial membrane. The

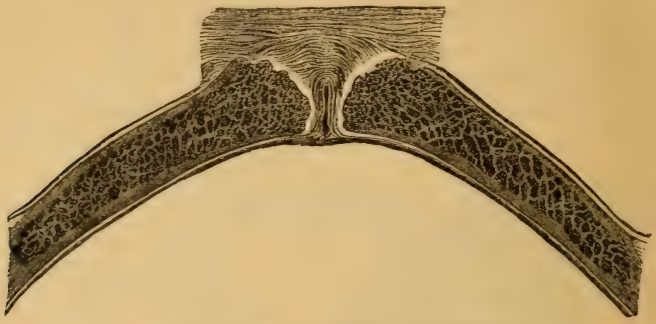


Fig. 74.—Section of symphysis. (Luschka.)

fibro-cartilage between the articulating surfaces of the bones is thicker in front than behind. The anterior ligaments are more developed than the posterior ones, and allow no movements of importance to take place in the non-pregnant condition.

The Pelvic Ligaments.—In addition to the ligaments which have already been noticed as contributing to the solidity of the joints, the

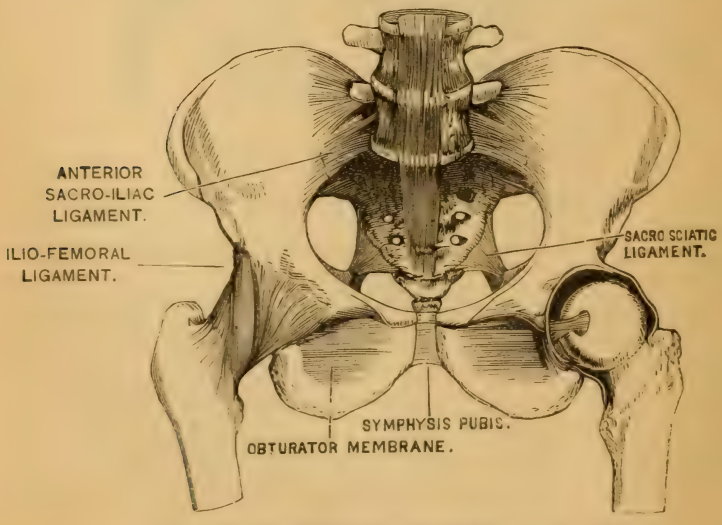


Fig. 75.—Front view of pelvis, with ligaments. (Quain.)

following help to close in the pelvis. Across the obturator foramen is stretched a fibrous septum, complete except where a small opening is left for the passage of the nerve and vessels.

The great sacro-sciatic ligament extends partly from the lower border of the sacro-iliac articulation, and partly from the lower border of

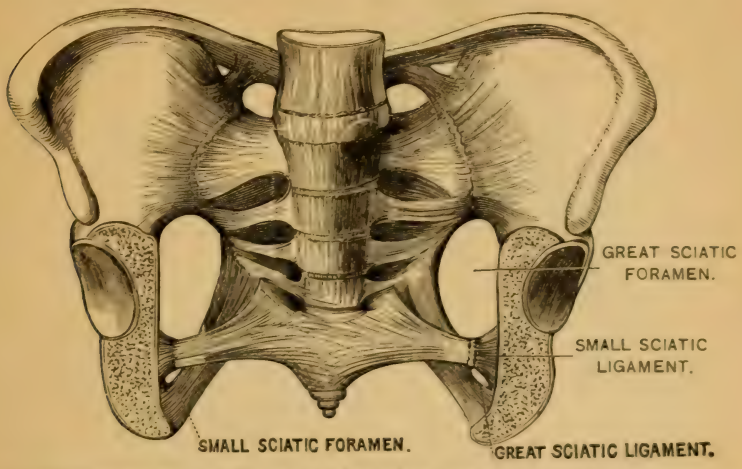


FIG. 76.—Transverse section through pelvis, to show the sacro-sciatic ligaments. (Tarnier et Chantreuil.)

the sacrum and coccyx, to the tuberosity of the ischium. The small sacro-sciatic ligament lies in front of the preceding, and extends from the side of the sacrum and coccyx to the spinous process of the ischium. These two ligaments close the large and small sacro-sciatic notches, and convert them into two foramina, which bear the same name.

The Inclination of the Pelvis.—The plane of the brim of the pelvis was formerly supposed to run nearly parallel to the horizon, whence the term "horizontal ramus," applied to the upper branch of the pubes. As a fact, however, in the upright position, the inclination of the brim to the horizon varies from 45° to 100°. According to Meyer, the center of gravity, instead of passing directly through the median line of the acetabula, is situated somewhat posteriorly, so that a tilting of the pelvis backward is only prevented by the strong ilio-femoral ligaments (Fig. 75). Whatever, therefore, serves to relax the ligaments in question diminishes the angle of inclination, while positions that increase the natural tension cause the pelvis to assume a nearly vertical attitude. Experimentally Meyer found that the pelvic inclination was diminished to the greatest extent when the thighs were moderately separated and rotated slightly inward, while its increase was due to four conditions: closing the knees, stretching the legs widely apart, external rotation, and exaggerated internal rotation. Naegele endeavored

to ascertain the normal inclination upon the living subject, by determining the distance between the extremity of the coccyx and a horizontal line drawn from the lower border of the symphysis, and then placing the bony pelvis in a position conforming to the measurement

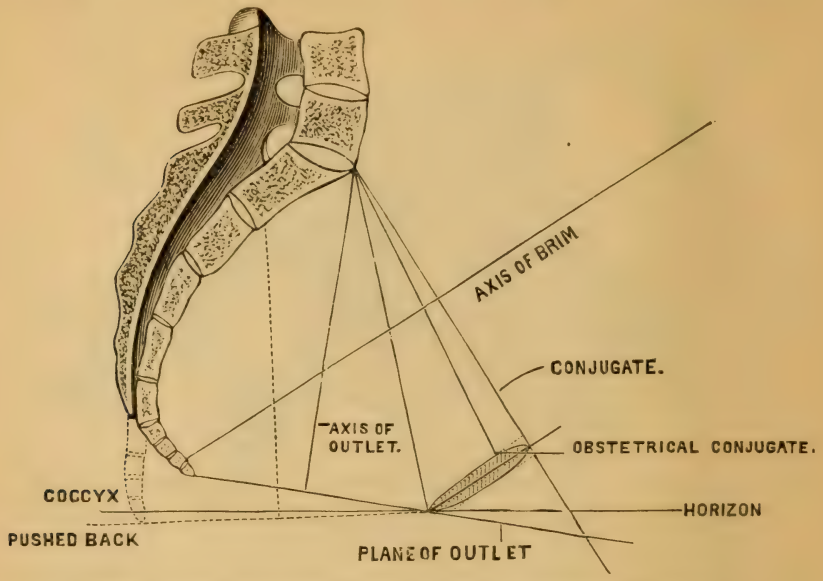


Fig. 77.—Section showing the inclination of the pelvis according to Naegele. (Tarnier et Chantreuil.)

thus obtained. He found in this way that the mean inclination was nearly 60°, a result explained by the fact that the method of measurement rendered a separation of the knees, and consequently an increase of tension of the ilio-femoral ligaments, a matter of necessity.*

Movements at the Pelvic Articulations.

At the symphysis pubis during gestation the fibers which compose its fibro-cartilage become infiltrated with serum, and the ligaments elongate, so that at term the distance between the articular surfaces of the pubic bones is increased twofold. Budin has shown that if the patient, when the finger is introduced into the vagina and pressed upward against the lower border of the symphysis, be made to walk, an elevation of the ramus upon the side of the extremity in motion can be distinctly recognized. In the rule, this mobility is most marked in women who have borne a number of children.†

Zaglass first pointed out that, in spite of the close union at the

* Schroeder, Lehrbuch der Geburtshülfe, 6te Aufl., note, p. 7; Naegele, 8te Aufl., p. 31.

† Tarnier et Chantreuil, Traité de l'art des accouchements, p. 239.

sacro-iliac articulation, a certain degree of mobility between the sacrum and iliac bones existed. Thus, in defecation, when the body is thrown forward, the promontory is tilted toward the symphysis, and the inferior extremity of the sacrum is thrown backward, thereby enlarging the outlet of the pelvis. Matthews Duncan describes similar movements, only exaggerated in extent, during pregnancy, and points out how they practically contribute to facilitate labor. Thus, at the beginning of labor, as the head enters the brim, the woman naturally chooses to sit up, to walk about, or, if in bed, to recline with the lower extremities extended — positions which favor the rotation backward of the upper portion of the sacrum, and the consequent increase of the antero-posterior diameter at the superior strait. As the head, however, descends to the floor of the pelvis, the patient instinctively draws up her knees, throws the body forward, and during a pain contracts the abdominal muscles. In this way she succeeds in tilting up the pubes, in pressing the promontory forward, and in rotating the point of the sacrum backward, so as to perceptibly increase the conjugate diameter at the pelvic outlet.

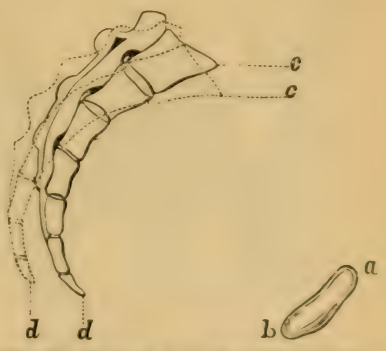


FIG. 78.—Diagram showing oscillatory movements of sacrum. (Duncan.)

The Pelvis as a Whole.—The pelvis is divided by the linea terminalis into an upper and lower portion.

The upper, or, as it is usually termed, the large pelvis, is composed of the lumbar vertebræ and the upper surfaces of the wings of the sacrum behind, the spreading portions of the ilia upon the sides, while the anterior segment is closed in by the muscles of the abdominal parietes. In shape, the bony part of the large pelvis has been compared to the rim of a barber's basin. Obstetrically the iliac fossæ are of interest, inasmuch as they furnish shelves upon which the head of the fœtus in multiparæ commonly rests during the latter part of pregnancy. The inclination of the ilia to the horizon, the shape of the crests, and the distance between the two anterior superior spinous processes, are important points for study,

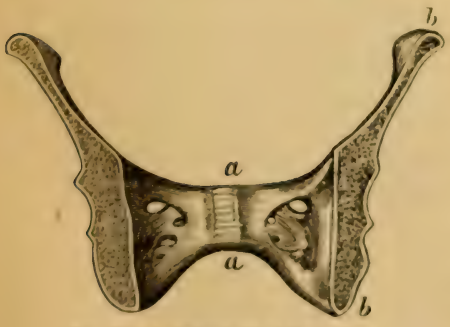


FIG. 79.—Anterior half of the pelvis.

because they furnish data upon which valuable inferences are based, in cases of pelvic deformity, relative to the shape and dimensions of the pelvic canal.

It will be remembered that the crests of the ilia possess an S-shaped curve. Normally, the widest distances between the crest measure ten inches; the distance between the anterior superior spinous processes measures nine inches.* The slope of the inner surfaces of the ilia is such that an extension of the lines drawn from the crest to the linea terminalis would meet in the neighborhood of the fourth sacral vertebra.

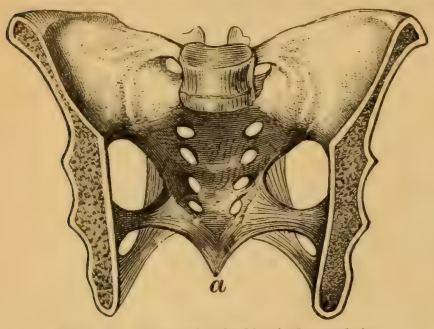


FIG. 80.—Posterior half of the pelvis.

The inferior or small pelvis comprises the portion below the linea terminalis. It is formed by the sacrum, the coccyx, the lower portion of the ilia, the ischia and pubes, the obturator membrane, and the sacro-sciatic ligaments. Together the foregoing inclose a basin-like cavity, which, though open below in the skeleton, is closed in by soft parts in the living subject. The posterior wall, formed by the sacrum and coccyx, measures five inches in a direct line from the promontory to the apex; the anterior wall at the symphysis pubis measures one and three quarters inch; the lateral walls, from the linea terminalis to the tuberosities of the ischia, measure three and three quarters inches. The posterior wall is curved; the symphysis pubis slopes downward and inward, so as to run nearly parallel with the two upper sacral vertebræ; the rami of the pubes approach one another at an angle of 95° to 100°, and unite beneath the symphysis in the form of an arch, the arcus pubis; the side walls are solid in front where they are constituted by the ischia, while behind the great sciatic notch is closed only by soft structures and the sacro-sciatic ligaments. The transverse diameter, owing to the incline of the side walls, narrows toward the outlet.

The Planes and Axes of the Pelvis.—The eccentric forms of the pelvic bones render it extremely difficult to convey a clear impression of the nature of the pelvic inclosure. As a means to this end, it is

* As no two pelves possess precisely the same dimensions, pelvic measurements are given somewhat differently by authors. They are obtained either by taking the mean of a large number of pelves (a method which furnishes fractions difficult to remember, but offering no special advantages in the way of accuracy), or by selecting as the normal standard either a whole number, or, where fractions are necessary, the nearest half or quarter approximating to the mean average. The latter plan recommends itself in practice equally on the score of utility and convenience.

customary to study a series of planes drawn at different levels through the pelvic walls, which serve to show the changes in the shape and dimensions of the bony canal at selected points of observation. By a plane is meant simply a mathematical surface, without reference to depth or thickness.

The upper and lower openings are both somewhat contracted, and hence are termed respectively the superior and inferior straits, while the space between is denominated the cavity of the pelvis.

The first plane requiring our attention is that of the superior strait or brim. It is bounded by the linea terminalis, and has an elliptical

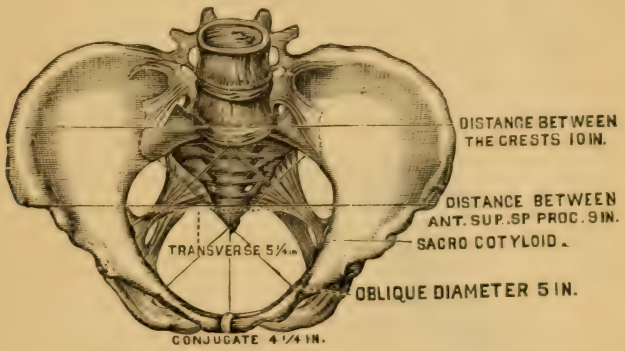

DISTANCE BETWEEN THE CRESTS 10 IN.
DISTANCE BETWEEN ANT. SUP. SP PROC. 9 IN.
SACRO COTYLOID
TRANSVERSE 5¼ IN.
OBLIQUE DIAMETER 5 IN.
CONJUGATE 4 ¼ IN.

FIG. 81.—Diameters of the brim.

contour, with a depression posteriorly, produced by the projection of the promontory of the sacrum.

The dimensions of each plane are determined by measuring the antero-posterior, the transverse, and the two oblique diameters.

FIG. 82.—Diameters of the outlet.

The antero-posterior, or, as it is generally termed, the conjugate diameter, extends from the upper border of the symphysis pubis to the promontory. Its length is four and a quarter inches. About two fifths of an inch below the upper border of the symphysis is situated the obstetrical, as distinguished from the anatomical, conjugate. The length of the former, owing to the thickening of the pubic bones, is reduced to four inches.

The transverse, sometimes termed the bis-iliac, diameter is the widest distance between the ilia. It measures five and a quarter inches.

The oblique diameters extend from the ilio-pectineal eminences to the opposite sacro-iliac articulations. The distance between the points mentioned is five inches. The right oblique diameter is the one directed to the right, and the left to the left sacro-iliac articulation.

The axis of the superior strait is represented by a line drawn perpendicular to the center of the plane. The extension of this line falls below upon the extremity of the coccyx, and above strikes the abdomen near the umbilicus (*vide* Fig. 98). The circumference of the brim is very nearly sixteen inches.

The inferior strait proper, or outlet of the pelvis, is bounded by the sub-pubic ligament, the pubic rami, the rami and tuberosities of the ischia, the sciatic ligaments, and the coccyx. Owing to the projection of the ischia, the surface of the pelvic outlet is rendered convex, or, perhaps, is better described by supposing it to be composed

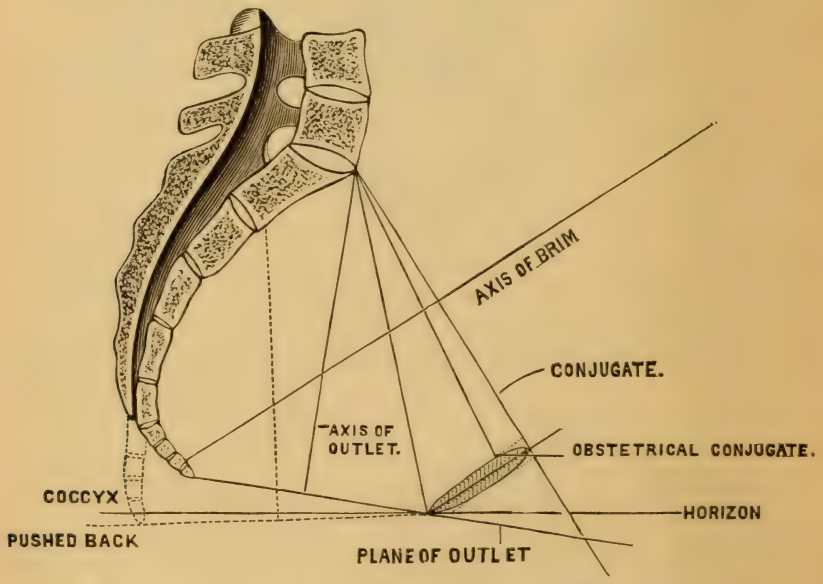


FIG. 83.—Section showing the inclination of the pelvis according to Naegele. (Tarnier et Chantreuil.)

of two obtuse-angled triangles with apices at the symphysis and coccyx, and with a common base formed by a line drawn through the ischia.

The antero-posterior diameter extends from the lower border of the symphysis to the extremity of the coccyx. It measures three and three quarters inches, though, when the coccyx is pushed backward, the distance may be extended to four and a half inches.

The transverse diameter between the inner borders of the tuberosities measures four and a quarter inches.

Owing to the elasticity of the sciatic ligaments, the oblique diameters are not regarded as of obstetrical importance.

The axis of the inferior strait, when the coccyx is not disturbed, strikes the promontory. When the coccyx is pushed backward, a perpendicular line drawn from the center impinges upon the lower border of the first sacral vertebra.

The circumference of the inferior strait measures thirteeen and a half inches.

The pelvic cavity or canal possesses an irregular, cylindrical shape, constricted somewhat above at the superior strait, and narrowing rapidly at the pelvic outlet. Below the brim the dimensions are increased considerably by the concavity of the sacrum. Thus, a plane passing through the lower portion of the symphysis pubis, and across the upper margins of the acetabula, to the junction of the second and third sacral vertebræ, gains three quarters of an inch in the conjugate, while the transverse diameter is barely one fourth of an inch less than the transverse diameter of the brim. The narrowing at the outlet is most marked in a plane drawn so as to intersect the spines of the ischia and the extremity of the sacrum. At the level indicated, the distance between the spines (transverse diameter) is but four inches, and the antero-posterior diameter four and a half inches.

The sciatic spines divide the pelvic cavity into two unequal sections. In the larger, anterior section, the lateral walls slope toward the symphysis and arch of the pubes, while posteriorly the walls slope in the direction of the sacrum and coccyx. The declivities in front of the spines are termed the anterior inclined planes of the pelvis, over which rotation of the occiput takes place in the mechanism of normal labor. Behind the spines the lateral slopes are known as the posterior inclined planes. Meeting together in the median line of the sacrum, they constitute a sort of vault, into which the face is turned after rotation is completed.

Fig. 84.—Axis represented upon a vertical section through a plaster cast of the pelvic cavity. (Hodge.)

The general direction of the pelvic cavity is best shown by a line representing the axis of the bony channel. It should, however, be stated in advance that the so-called pelvic axis of obstetrical writers is not to be construed as the median line of a cylinder in a strict mathematical sense, but is really intended to indicate very nearly the course which a round body like the fetal head would naturally pursue in its course through the parturient canal. In practice it is convenient to follow the suggestion of Hodge, and draw a plane from the supra-pubic ligament backward to the sacrum, and parallel to the plane of the superior strait.

This second parallel would intersect the middle portion of the second sacral vertebra. Inasmuch as the pubic walls run nearly parallel to the upper portion of the sacrum, the axis of the cavity included between the two planes may be regarded as continuous with the axis of the brim. Below the second plane, owing to the curvature of the sacrum, the axis describes a nearly circular course, with intersecting planes radiating from the lower border of the symphysis as a center. Further on it will be shown that the axial curve is continued beyond the bony canal by the distended tissues which form the floor of the pelvic basin.

Differences between the Male and Female Pelvis.—In the male, the bones of the pelvis are thick and solid; the brim is triangular in shape; the promontory projecting; the cavity deep, and sloping inward like a funnel; the sacrum long, narrow, and moderately curved; and the arch of the pubes is formed at an angle of from 75° to 80°. In the female, on the contrary, the bones are lighter and more delicate in contour, therein corresponding to the inferior muscular development of the sex; the brim, owing to the less marked jutting inward of the promontory, has an elliptical outline; the diameters, both antero-posterior and transverse, are increased; the pelvic inclination is more pronounced; the sacrum is wider and more concave; the tuberosities of the ischia are wider apart; the angle of the arch of the pubes measures from 90° to 100°; and the entire depth of the pelvis is diminished. As a result of the increased transverse diameter in the female, the trochanters are at a greater relative distance from one another, and are directed somewhat obliquely to the front. This peculiarity brings the knees in close proximity, and accounts for the characteristic feminine gait.

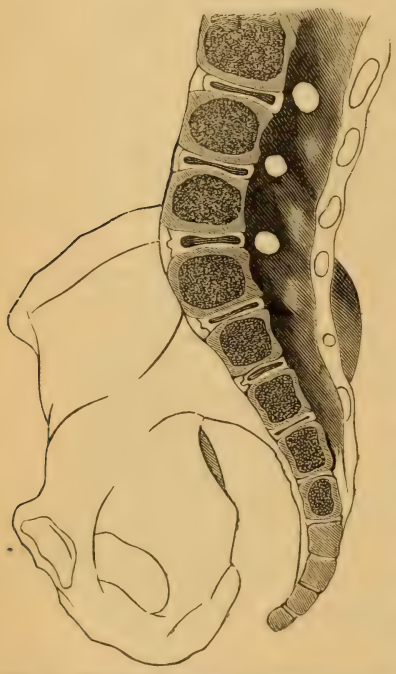
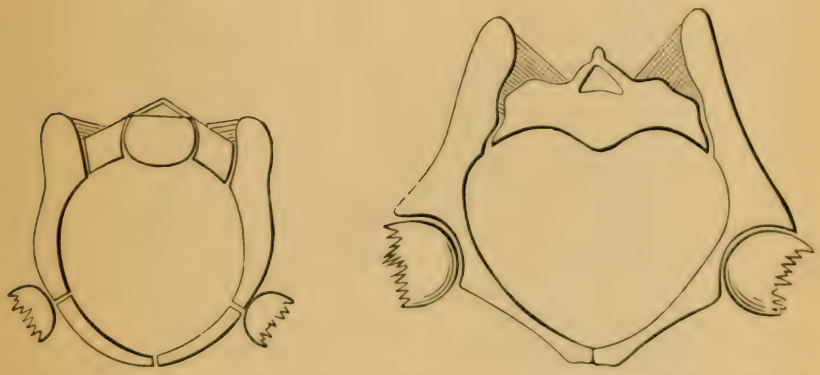


FIG. 85.—Vertical section of a female infantile pelvis. (Fehling.)

The configuration of the female pelvis, though unfavorable to rapid locomotion, is in a special degree adapted to render possible the birth of the child. A female pelvis approximating in type to that of the male gives rise to a variety of dystocia of a very formidable character.

Differences between the Infantile and Adult Pelvis.—In the infantile pelvis the promontory occupies a relatively higher position above the upper border of the symphysis; the last lumbar and two upper sacral vertebræ possess a moderate convexity—i. e., the promontory does not project forward, as in the adult; the sacrum, after running a straight course, begins to curve forward first at the fourth vertebra; the alæ are slightly developed; the inclination of the ilia more nearly approaches the perpendicular; the S-shaped curve of the crests is barely indicated, there being but slight difference in the distances between the crests and anterior superior spines; the conjugate diameter in proportion to the transverse is increased; the side-walls converge toward the outlet; the pubic arch is formed at an acute angle; and the distance between the spines of the ischia is greater than the transverse diameter of the outlet.

Distinctions pertaining to sex are but slightly accentuated. In the female, the sacrum, owing to the smaller size of the vertebræ, is narrower than in the male; the side walls are higher; the symphysis



FIGS. 86, 87.—Diagrammatic representations of sections through the infantile and adult pelves. (Schroeder.)

lower; the iliac incline approaches more nearly a vertical line; the pubic arch is less acute; and the transverse diameter is increased.

The most important agent in effecting the changes which characterize the adult pelvis is unquestionably the weight of the trunk. Owing to the wedge-shape of the sacrum, and the shelf-like ledge which projects from the lower surface of the iliac articulation, no displacement can take place in the direction of the long axis of the auricular surfaces. But, when we bear in mind the inclination of the pelvis, it is obvious that pressure from above must act upon the sacrum likewise in a downward, forward, and inward direction. Now, if the sacrum were, as it is sometimes represented, the key-stone of the pelvic arch, its position would be fixed between the ilia. We owe to

Duncan,* however, the demonstration that this view is incorrect, and that in reality the sacral articulation slopes backward and inward in the direction of the median line. The fact that the sacrum does not under pressure drop from the arch is due to the strong sacro-iliac ligaments, which hold it in position as part of the bony ring. The ligaments do not, however, prevent the sacrum from sinking forward to a limited extent into the pelvic cavity, as is shown in the projection backward at maturity of the tuberosities of the ilia, whereas in the infantile pelvis the dorsal surface of the sacrum is level with the posterior superior spinous processes.

As the line of gravity of the trunk falls in front of the sacrum, the weight from above presses the promontory forward and inward toward the symphysis pubis. At the same time the rotation backward of the sacral apex is restrained by the sciatic ligaments. The natural effect of these two simultaneously operative forces, acting at a period when ossification is still incomplete, is to increase the sacral curve, and consequently to shorten the distance between the upper and lower ends of the base. As a result, the height of the promontory is diminished, the pelvic brim and outlet become constricted, and the dimensions of the pelvic cavity are increased. The upper portion of the sacrum, in rotating forward, drags upon the posterior ligamentous attachments of the ilia. This traction would, were it not for their union at the symphyses and the pressure of the heads of the thigh-bones, cause the ossa innominata to revolve around the sacral articular surfaces, like doors upon their hinges. As a result of the antagonistic action of the symphysis and the sacro-iliac ligaments, however, the ossa innominata bend at the point of least resistance in front of the sacrum, and in this way an increase takes place in the transverse at the expense of the antero posterior diameter.

The sexual differences are attributable to differences in the character of the pelvic contents and the external sexual organs, to differences in muscular development, and to certain distinctive peculiarities of growth. Thus, in the female eunuchs of India, described by Roberts,† there were absence of vagina and complete atrophy of cellular tissue in the genital organs; at the same time the pelvis approximated to the male type, and, in place of the pubic arch, the rami of the pubes and ischia appeared as though they were in contact at the site usually occupied by the vagina.

In fetal life, the female sacrum, owing to the small size of the vertebræ, is narrower than in the male. Subsequently the more rapid growth of the alæ becomes the cause of the increased width which characterizes the sacrum of the female at maturity. The larger circumference of the brim in the female is due partly to this difference

* Duncan, Researches in Obstetrics.

† *Vide* Tilt, Uterine and Ovarian Inflammation, p. 63.

in the width of the sacrum and partly to the greater length of the linea innominata.

The Soft Parts of the Pelvis.—Prefatory to the history of the impregnated ovum, we have already considered the more important pelvic viscera concerned in generation and parturition. In studying the mechanism of labor, it is, however, necessary in addition to recall—1. The soft tissues which encroach upon the pelvic space; 2. The

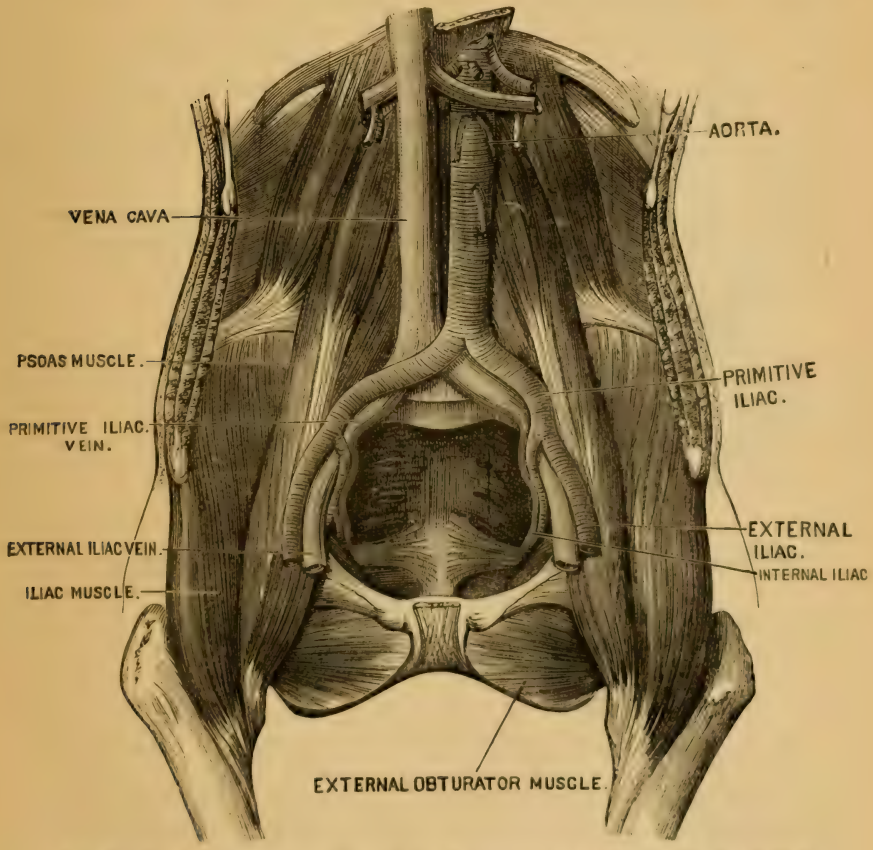


FIG. 88.—Pelvis covered with the soft parts, with removal of bladder, uterus, and rectum.

structures which close in the openings of the pelvis, and convert it into a basin-like cavity.

1. The diameters of the brim are diminished somewhat by the ilio-psoæ muscles. The iliac muscles proper occupy the entire surface of the internal iliac fossæ. The fibers converge below, and, passing beneath Poupart's ligament, become united to the borders of the psoas muscle. The pelvic portion affords a soft cushion for the support of the gravid uterus. The great psoæ muscles fill out the spaces upon

the sides of the promontory. They take their origin from the lateral surfaces of the bodies and transverse processes of the four upper lumbar and the last dorsal vertebræ. They cross the pelvis parallel to the linea innominata, which, however, they slightly overlap. They taper below, and, passing beneath the femoral arch, terminate in a tendon, which is inserted into the small trochanter. These two muscles flex the thighs upon the abdomen. The iliac muscle likewise acts as an abductor, and the psoas serves to flex the pelvis upon the spinal column. The ilio-psoæ muscles diminish the transverse diameter nearly a half-inch, so that the latter becomes very nearly equal in length to the oblique diameters. When the limbs are extended and the muscles are rendered tense, the influence they exert in lessening the pelvic space is somewhat greater than when they are relaxed by flexing the legs upon the thighs.

The large arteries and veins at the pelvic brim do not undergo compression during labor under normal conditions. When, however, con-

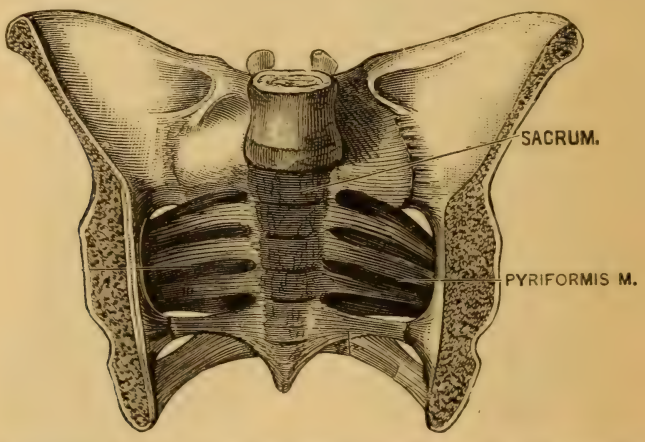


Fig. 89.—Section of pelvis, showing the pyriform muscles. (Tarnier et Chantreuil.)

siderable disproportion exists between the pelvis and the child's head, the effects of pressure are sometimes manifested in the swelling of all the soft tissues within the pelvic cavity—a swelling which, in turn, enhances the difficulties of delivery.

2. The open spaces of the pelvis, which are closed in by soft parts, are the great sciatic notches, the obturator foramina, and the pelvic outlet.

The closure of the sacro-sciatic notches is effected by the pyriformis muscles. The pyriformis muscle has a triangular shape. Its base presents a series of digitations which are inserted upon the lateral portions of the anterior surface of the sacrum, along the outer borders of the four lower sacral foramina and the upper portion of the sacro-

sciatic ligament. It then crosses the large sciatic foramen, and, passing outward, terminates in a tendon, which is inserted into the large trochanter.

The obturator foramen is covered by the internal obturator muscle. The latter is attached to the quadrilateral surface which corresponds to the cotyloid cavity, to the circumference of the foramen, and to the inner surface of the obturator membrane. Its fibers converge to form a tendon, which passes through the lesser sciatic foramen, and thence is directed downward and backward to the digital cavity of the great trochanter.

Owing to their tenuity, and to the fact that they form distensible coverings to spaces limited only by elastic tissues, neither the pyriform nor the obturator muscles appreciably affect the dimensions of the pelvic cavity.

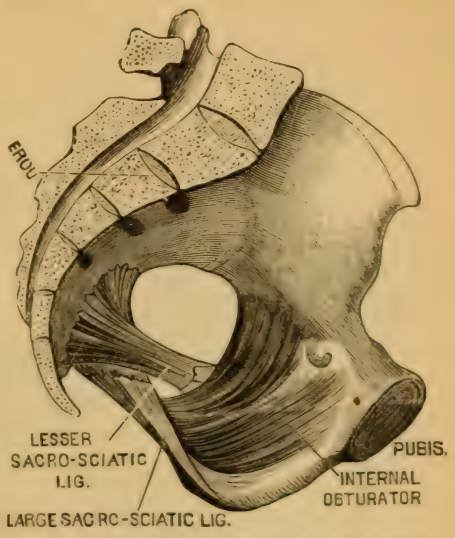


Fig. 90.—Section of pelvis, showing the internal obturator muscle. (Tarnier et Chantreuil.)

The outlet of the pelvis is closed by a succession of layers, which together constitute the perineal or pelvic floor. These layers, passing from without inward, consist respectively of the external cutaneous tissue, the muscular layers with their associated aponeuroses, the subperitoneal cellular tissue, and the peritonæum.

The most important structure which enters into the formation of the perineal floor is the levator-ani muscle. This muscle is attached above partly to the horizontal rami of the pubes, about an inch and a half below the upper border of the rami, and partly to the tendinous arch of the pelvic fascia, which is situated about two inches below the ilio-pectineal line, stretching from the inner border of the pubes to the spines of the ischia. The pubic portion consists of separate bands, about two fingers in width. These sweep nearly horizontally backward, and are united behind the rectum, which they encircle like a collar. The anterior insertions are about an inch apart from one another. The fibers attached to the tendinous arch do not possess a uniform arrangement. Passing from before backward, we have first a band a few lines in width, which crosses the pubic bundles and descends to the recto-vaginal septum; next, large bundles descend from the two sides and meet behind the rectum; then follows a smaller

median portion, whose fibers are united by a tendinous raphe in front of the coccyx, while posteriorly a narrow bundle is fastened by a tendon to the fourth coccygeal vertebra. The arrangement of the muscular fibers is best seen from the side, as in Fig. 92, where the ischium has been removed.

The margins which border the rectum and vagina are thicker than the rest of the levator. They are closely attached to those organs by strong connective tissue. They cross the vagina beneath the bulbs

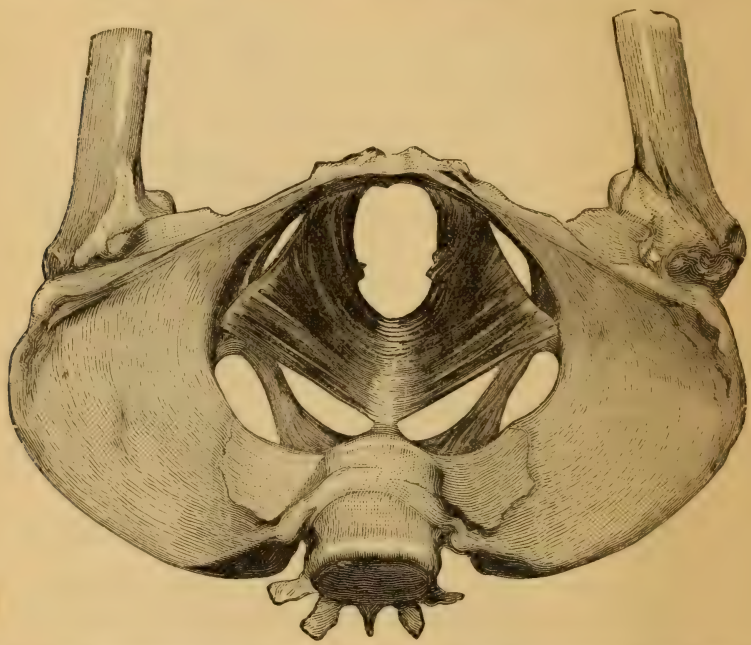


FIG. 91.—The levator-ani muscle as seen from above, with the tendinous arch which spans the obturator muscle. (Dickinson.)

the vestibules; the rectal crossing is on a level with the upper fibers of the external sphincter. The contraction of the muscle draws the rectum and vagina toward the symphysis. The average power exerted is estimated by Dickinson* at ten pounds, rising in certain cases to twenty-seven pounds.

The levator measures from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch in thickness. It becomes, however, hypertrophied during pregnancy.

The muscular floor of the pelvis is rendered complete by the coccygeus muscle, situated between the levator and the pyriformis, and in front of the small sciatic ligament. The base is attached to the sides

* DICKINSON, Studies of the Levator Ani Muscle, Am. Jour. Obstetrics, Sept., 1889, p. 909. To this article I am indebted for the changes made in the present text.

of the coccyx and the lower extremity of the sacrum; the insertion of the apex is at the spine of the ischium. In caudate animals the coccygeus is strongly developed, and enables them to move the tail laterally.

The upper surface of the levator-ani and coccygeal muscles is concave. The muscles themselves are flattened, and alone are capable of affording but feeble support to the superimposed viscera. They are,

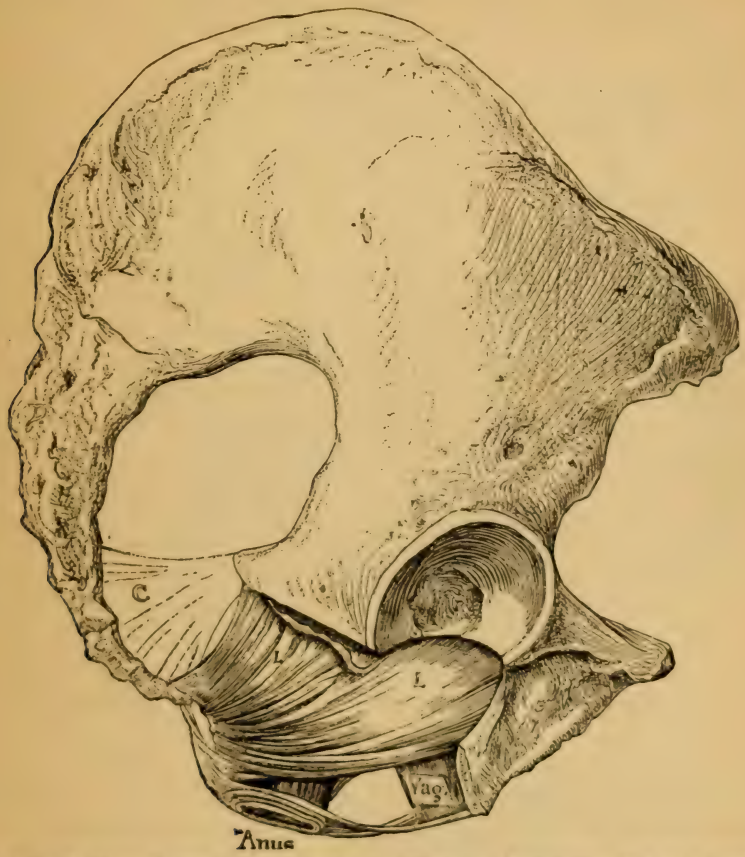


FIG. 92.—The levator (L) seen from the side when the ischium is removed. The lower bundles are the strong and heavy ones. The sphincter ani is shown surrounding the anus and the coccygeus is faintly indicated. (Redrawn from Luschka by Dickinson.)

however, above closely attached to the strong tissues of the internal pelvic fascia, which possess the qualities of elasticity and toughness.

The internal pelvic fascia is attached to the upper border of the superior strait, where it meets the fascia which lines the iliac fossæ and the transverse fascia of the abdominal walls. It covers the pyriformis and the upper half of the obturator muscles. In front it descends from the symphysis to the neck of the bladder, and forms the pubo-vesical ligament. From the linea terminalis to the arcus ten-

dineus the fascia upon the side walls is firmly attached to the periosteum. The tendinous arch marks the line at which the fascia leaves the pelvic walls to form the inner lining of the levator and coccygeal muscles.

The upper surface of the internal pelvic fascia is covered by the peritonæum, to which it is united by loose connective tissue.

The fascial coverings beneath the levator-ani muscle are divided into a posterior and anterior portion by a line drawn between the two ischia.

The posterior portion consists of a single layer. It starts from the sacro-sciatic ligaments and the tuberosities of the ischia; thence it mounts upward over the inner surfaces of the ischia and the obturator internus muscle to the tendinous arch, which it contributes to form, and from the tendinous arch is reflected at an acute angle over the inferior surface of the levator-ani muscle. The space thus limited between the side walls of the pelvis and the levator ani is termed the ischio-rectal excavation.

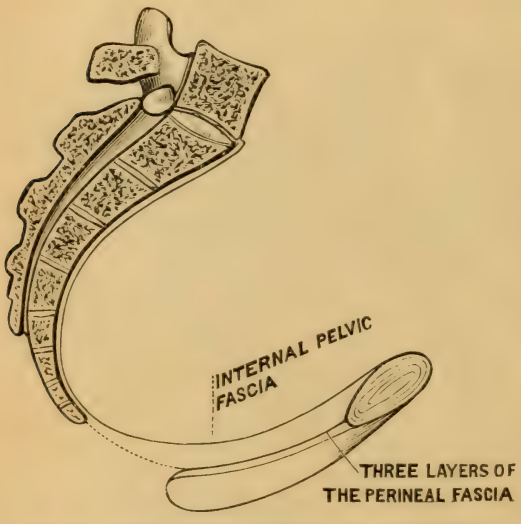


FIG. 93.—Antero-posterior section of the perineal floor. (Tarnier et Chantreuil.)

The anterior portion, or perineal fascia proper, fills the space between the bis-ischiatic line and the arch of the pubes. It is composed of three layers, as follows: 1. The deep perineal fascia, which covers the lower surface of the levator ani; 2. The median perineal fascia, separated from the former by a narrow interval, and inclosing the pudic vessels and nerves; 3. The superficial perineal fascia which forms, with the median layer, a shallow compartment in which are lodged the superficial muscles of the perinæum, the bulbs of the vagina, the vulvo-vaginal glands, and the rami of the clitoris. Each one of these organs, except the latter, is, moreover, enveloped in a special sheath, derived from prolongations of the upper surface of the aponeurosis.

The superficial perineal muscles are of slight obstetrical importance. They are the constrictor vaginæ, the ischio-cavernosi, and the transversi perinæi.

The constrictor vaginæ consists of two small lateral muscles, situ-

ated upon the outer sides of the vestibular bulbs, and surrounding the vulvar orifice. Posteriorly the extremities of the main muscle start from the perineal fascia at a point nearly midway between the sphincter ani and the ischia, while a small bundle only is connected with the sphincter ani itself.* Above, the convergent ends separate into a superficial and deep portion. The superficial portions terminate in a tendon which unites them together above the dorsal vein of the clitoris; the deep portions pass between the upper ends of the bulbs and the clitoris, and are likewise united by an aponeurosis.

The action of the muscle consists chiefly in compressing the veins crossed by its tendon, and in thus enhancing the turgidity of the erectile

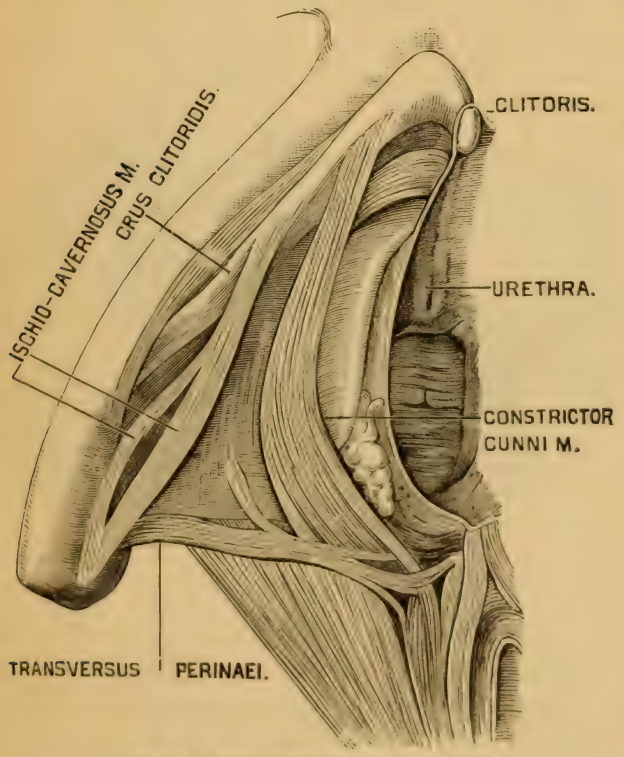


FIG. 94.—Muscles of the perinæum. (Henle.)

apparatus. It is in no sense a sphincter muscle, though, by pressing the turgid bulbs inward, it may narrow the vestibule of the vagina.

The ischio-cavernosi muscles form a fibro-muscular sheath about the crura of the clitoris. They are united together above by an aponeurosis which crosses the posterior extremity of the body of the clitoris. During sexual excitement these muscles are capable not only of com-

* LUSCHKA, Anatomie des menschlichen Beckens, p. 399.

pressing the crura, thereby forcing the blood toward the body of the clitoris, but, through the pressure exerted by the aponeurosis upon the dorsal vein, they help to retard the return of the blood from the turgescent organ.

The transversi perinæi muscles are small, triangular, flattened muscles, which pass from the inner sides of the ischia, underneath the constrictor muscle, to the sides of the vagina and rectum. When the perinæum is lacerated, these muscles tend to produce gaping of the wound, and to interfere with union by first intention.

A mere enumeration, such as has been given, of the thin, flat, muscular and aponeurotic structures of the pelvic floor affords, however, a very incomplete idea of the true anatomy of the lower portion of the

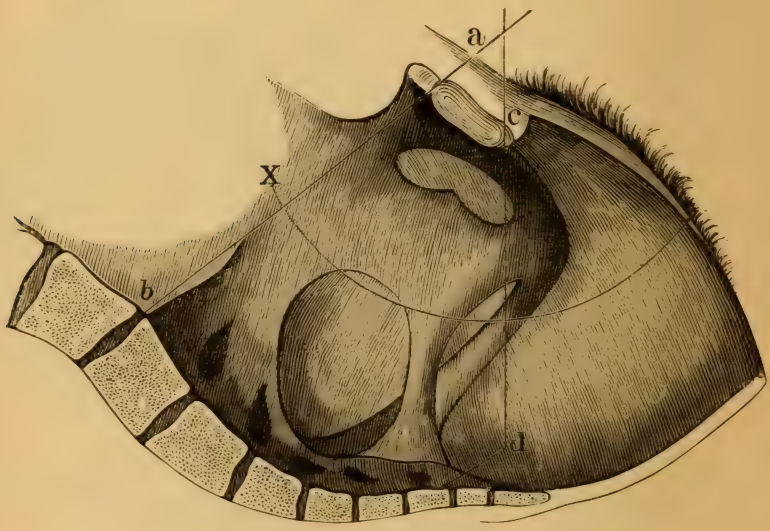


FIG. 95.—The parturient canal. (Hodge.)

parturient canal. Both as regards form and function, the *rôle* of the connective tissue which fills out all the available interstices between the different organs, the different muscular groups and the bony walls, is of the highest importance. It is to this tissue that the perineal body occupying the space between the vagina and rectum owes its extraordinary distensibility. In a sagittal section, the perineal body has usually very nearly a quadrangular shape.* Laterally it spreads out to the rami and the tuberosities of the ischia. In height it extends upward nearly one half the length of the vagina. Between the border of the anus and the posterior commissure of the vulva, the external portion, which forms the base of the triangle, measures on the average

* FOSTER, F. P., Anatomy of the Uterus and its Surroundings, Am. Jour. of Obstet., January, 1880.

an inch in length. When the head of the child, during labor, descends below the level of the bony walls, it bulges the perinæum and stretches it from four to five inches in the antero-posterior direction. Both the length and degree of curvature of the pelvic canal are thereby increased, the soft parts posterior to the vulva forming a gutter-like extension, the axis of which is continuous with that of the pelvis.

The Head of the Fœtus at Term.

The head is the part which presents the greatest mechanical difficulties in the passage of the fœtus through the parturient canal. It is therefore important to become familiar with its shape, its diameters, and the modification it undergoes during labor.

In studying the fetal head we distinguish the face and the cranium.

The face is of little importance in normal labors. It may, however, be here incidentally noted, what is sometimes of consequence in

Fig. 96.—Lateral view of fetal skull. (Hodge.)

Fig. 97.—Fetal head, as seen from above. (Hodge.)

extreme degrees of pelvic contraction, that the distance (two and a half inches) between the malar bones possesses but a slight degree of reducibility.

In the cranium we distinguish again between the upper compressible portion or vault and the lower incompressible portion or base of the skull. The vault is composed of the frontal and parietal bones and the squamous portions of the temporal and occipital bones. The base is formed by the union of the ethmoid, the sphenoid, the petrous portion of the temporal bones, and the basilar portion of the occipital bone.

The Sutures and Fontanelles.—The flat bones which form the vault are thin and imperfectly ossified, consisting, indeed, of little more than the diploë. Instead of union by serrated osseous borders, they are held in their relative positions by the periosteum and dura mater, which come into contact with one another and form membranous commissures between the bones. Where more than two bones meet at a given point, the ossification is apt to be incomplete, and spaces are left, covered only by membranes termed fontanelles.

The sutures, to which it will be found necessary to make constant reference, are the following: The frontal suture, situated between the

ununited halves of the frontal bone; the coronal suture, between the frontal and parietal bones; the sagittal suture, where the parietal bones meet at the top of the cranium; the lambda suture, so called from its resemblance to the Greek letter of that name, between the triangular portion of the occipital and the posterior borders of the parietal bones.

At the point of intersection of the frontal, the sagittal, and the coronal sutures the incomplete ossification of the frontal and parietal bones leaves a large open space of a rhomboidal shape, termed the anterior or large fontanelle, or sometimes simply the bregma. Of the four sides, the anterior are longer, often extending for some distance between the bones of the os frontis.

The posterior or small fontanelle is situated at the junction of the sagittal and lambda sutures. It is formed at the meeting of three bones, viz., the two parietal and the occipital, and possesses a triangular shape. In very many cases the ossification of the bones is complete at the time of delivery. Its site then is indicated by the angle formed by the posterior borders of the parietal bones, beneath which, as a consequence of labor, the occipital bone is usually found depressed.

Budin has recently demonstrated that the squamous or triangular portion is attached to the basilar portion of the occipital bone by means of a band of cartilaginous and fibrous tissue. A sort of hinge-joint is thus formed, which permits veritable movements of flexion and extension to take place.*

The flexibility of the cranial bones, the sutures, the fontanelles, and the fibro-cartilaginous bands of union, together enable very considerable changes to take place in the diameters of the fetal head during the progress of labor.

The Diameters of the Fetal Head.—The diameters of the child's head are a series of imaginary lines extending between fixed points, selected so as to indicate the dimensions of the largest segments which, in the different positions and presentations, engage in the pelvic canal. We distinguish diameters running in the antero-posterior, the transverse, and the vertical directions.†

The antero-posterior diameters are: 1. The occipito-mental; 2. The occipito-frontal; 3. The sub-occipito-bregmatic.

The occipito-mental diameter extends from the highest point of the occiput to the chin;‡ the occipito-frontal, from the occiput to the root of the nose; the sub-occipito-bregmatic, from the junction

* Budin, De la Tête du Fœtus, p. 72.

† The points of departure of the following diameters have been adopted from Budin's excellent monograph, already quoted.

‡ The occipito-mental diameter is usually referred to as the longest one of the head. According to Budin, the true maximum diameter is situated between the chin and a variable point in the line of the sagittal suture above the occiput.

of the occiput with the neck to the point of intersection in the large fontanelle of the coronal and sagittal sutures.

The transverse diameters are: 1. The bi-parietal; 2. The bi-temporal; 3. The bi-mastoid.

The bi-parietal diameter stretches between the two bosses or protuberances of the parietal bones; the bi-temporal, between the extremi-

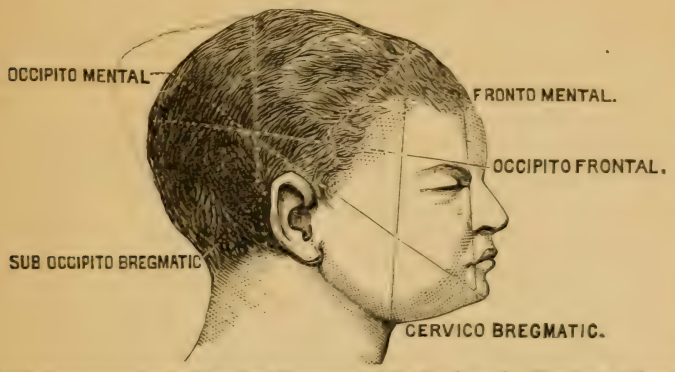


FIG. 98.—Antero-posterior and vertical diameters of the fetal head. (Tarnier et Chantreuil.)

ties of the coronal sutures; the bi-mastoid, between the mastoid processes at the base of the skull.

The vertical diameters are: 1. The fronto-mental; 2. The cervico-bregmatic.

The fronto-mental diameter extends from the top of the forehead to the point of the chin; the cervico-bregmatic, from the middle of the large fontanelle to the upper portion of the neck near the larynx.

In furnishing standard measurements of the foregoing diameters it is of course understood that no two heads present precisely the same dimensions. As a rule, as shown by Sir J. Y. Simpson, the heads of boys are larger than those of girls. In selecting type-cases it will be remembered too, that, owing to the plasticity of the head, in none are the diameters completely normal immediately after the transit through the generative passages. Unless, therefore, the child is delivered by Cæsarean section, sufficient time should be allowed to elapse after delivery before the measurements are made, to permit the head to return to its natural shape. Again, as in the measurements of the pelvis, the figures selected to represent the normal average should be such as admit of convenient recollection.

DIAMETERS OF FETAL HEAD.*

Occipito-mental diameter	5½ inches.
Occipito-frontal "	4½ "

* The diameters given are based upon the table in Tarnier and Chantreuil, which were averaged from measurements taken with great precision in forty-four cases.

Sub-occipito-bregmatic diameter	.....	3¾	inches.
Bi-parietal	"	3¾	"
Bi-temporal	"	3¼	"
Bi-mastoid	"	3	"
Fronto-mental	"	3½	"
Cervico-bregmatic	"	3¾	"

The circumference of the head, from the chin to the vertex, using the latter term to express the highest part of the skull, without reference to any fixed anatomical point, is about fourteen and three quarters inches. The circumference at the sub-occipito-bregmatic diameter is but thirteen inches.

The Articulation of the Head with the Spinal Column.—The movements of the occiput upon the atlas are extremely limited, those of extension and flexion, which the head executes so readily, taking place for the most part in the articulations of the cervical vertebræ. Movements of rotation are performed at the articulation between the axis and the atlas In practice, the head can not be turned with safety to either side beyond a quarter of a circle, though, when rotation is performed slowly after delivery, it may sometimes be carried to such an extent as to enable the face to look directly backward. The insertion of the spinal column at a point nearer to the occipital than the frontal extremity of the child's head is of supreme importance in the furtherance of the mechanical processes of labor. It converts the head into a lever, consisting of two unequal portions. When the head, therefore, encounters circular resistance in passing through the obstetric canal, pressure transmitted through the spinal column causes the descent of the occipital short end of the lever; while the pressure upon the forehead from the side walls flexes the chin upon the thorax, the degree of flexion depending upon the size of the canal through which the transit is made.

CHAPTER IX.

MECHANISM OF LABOR.—(Continued.)

Presentations: natural, unnatural, normal.—Vertex presentations: frequency, positions.—Manner in which head enters pelvis.—Positions, normal mechanism of labor.—Descent and flexion.—Rotation.—Extension.—External rotation.—Expulsion of the trunk.—Abnormal mechanism (vertex presentations).—Mechanism of occipito-posterior positions.—Configuration of the head in vertex presentations.—Molding.—Scalp-tumor.—Diagnosis of vertex presentations.

THE mechanism of labor—i. e., the manner in which the fœtus passes through the parturient canal—varies with the presentation.

The presentations are classified, in the first place, with reference

to the position of the fœtus in relation to the axis of the uterus. In cases where the long diameter of the fœtus coincides with that of the uterus, we have further to distinguish presentations of the head and presentations of the pelvic extremity.

Head or cephalic presentations comprise those of the vertex, i. e., the portion lying between the two fontanelles, the brow, and the face.

Pelvic presentations offer two varieties, viz., breech presentations and foot presentations.

When the long diameter of the fœtus crosses the axis of the uterus, there is produced a transverse, or, after the operation of uterine contractions, a shoulder presentation.

Vertex, face, and pelvic presentations are included in the category of natural labors. Brow and shoulder presentations are termed unnatural, as, with few exceptions, they are not terminable except by the resources of the obstetric art.

Vertex presentations alone are to be regarded as normal, as they only realize the mechanical conditions compatible with the highest degree of safety to both mother and child.

In the following pages it is purposed to associate with the descriptions of the mechanism of labor, in the various presentations and positions, an account of the means of diagnosis and the treatment suited to the special cases under consideration, instead of placing diagnosis, mechanism, and treatment in chapters distinct from one another. The writer believes, from long experience in teaching, that what is thus sacrificed in the way of systematic completeness is more than compensated by the clinical advantage of keeping in close proximity the principles of obstetric art and the rules of practice directly deducible from them.

Precedence of description is given to the vertex presentation as representing the normal type of labor.

Vertex Presentations.

In 93,871 births, collected from private practice, Spiegelberg found that in over ninety-seven per cent the cranial vault presented.* The back of the child *in utero* is directed in about seventy per cent of cases to the left, and in thirty per cent to the right, side of the mother. The fronto-occipital diameter of the head measures four inches and a half. The diameters of the pelvic brim, after deducting the soft parts, are nearly as follows:

Transverse diameter of brim	4¾ to 5 inches.
Oblique " "	4¾ to 5 inches.
Antero-posterior diameter of brim (minimum diameter about one third inch below the crista pubis)	4 inches.

* Spiegelberg, Lehrbuch der Geburtshülfe, p. 148.

Thus it will be seen that the fronto-occipital diameter of the head may, at the brim, enter the pelvis without meeting with any special resistance in either the transverse or oblique diameters. In the conjugate diameter, on the contrary, this is not possible. Transverse positions, where the conditions are normal, are of very exceptional occurrence, though they form the rule in flattened pelves. Tarnier * suggests that this infrequency is partially explicable on mechanical grounds. The long transverse diameter of the pelvis, he says, is, owing to the projection of the promontory, situated in a line considerably posterior to the point at which the sagittal suture normally meets the conjugate. When the head, therefore, enters the pelvis in a transverse direction with both parietal bones upon the same plane, the fronto-occipital diameter corresponds to a shortened chord subtending two points of the pelvic ring in front of the anatomical transverse diameter; in point of fact, therefore, the latter, at the site of engagement, is less than either of the oblique diameters. In flattened pelves this difficulty does not exist, as, in place of both parietal bones entering upon the same level, the posterior is turned toward the corresponding shoulder, the anterior dipping obliquely into the brim (lateral obliquity of Naegele), an arrangement by which the long diameter of the head is brought into correspondence with the long diameter of the pelvis.

At the time when the sagittal suture is accessible, and it is possible to observe with correctness, the antero-posterior diameter of the head is found to approximate to one or the other of the pelvic oblique diameters.

It is customary to classify the positions of the head with reference to the direction of the occiput. Most English authorities admit four varieties, viz.:

The right occipito-anterior (occipito-dextra anterior, O. D. A.), the right occipito-posterior (occipito-dextra posterior, O. D. P.), the left occipito-anterior (occipito-læva anterior, O. L. A.), the left occipito-posterior (occipito-læva posterior, O. L. P.).

Naegele first called attention to the fact that the head approximates, in an overwhelming proportion of cases, to the right oblique diameter; that, therefore, when directed to the left, the occiput is turned to the cotyloid cavity, and, when directed to the right, it looks toward the sacro-iliac synchondrosis. This peculiarity probably results from the fact that the uterus is usually rotated in such a way upon the spine that the right side inclines obliquely backward, while the left side is turned somewhat to the front.

Naegele's observation is undoubtedly correct as regards the position of the head after labor has actually begun. Sutugin,† however, main-

* Tarnier et Chantreuil. Traité de l'art des accouchements, p. 465.

† Sutugin, Beiträge zum Mechanismus der Geburt bei Schädellagen, Klinischer Vorträge, No 310.

tains that when the patient is examined in the recumbent position during pregnancy abdominal palpation shows that, as a rule, the back of the child, whether situated to the right or the left of the vertebral column, is turned somewhat posteriorly.

At the beginning of labor the head, surrounded by the lower segment of the uterus, is commonly found at the brim or resting upon an iliac fossa in multiparæ, and below the brim, within the pelvic cavity, in primiparæ. The direction of the head, as regards its vertical axis, depends upon the degree of resistance afforded by the contiguous uterine tissues. In the softened, relaxed condition often observable in multiparæ toward the close of pregnancy, the two fontanelles are not infrequently situated upon the same level. Where the lower uterine walls are firm and slope toward the os internum, the weight of the child's body, transmitted through the vertebral column, depresses the occiput. At the same time the sloping uterine walls, acting upon the frontal extremity of the child's head, direct the chin toward the thorax, thus producing a state of semi-flexion.

The Normal Mechanism of Labor.

The mechanism of labor in vertex presentations is usually described as consisting of a series of acts, termed respectively descent, flexion, rotation, external restitution, and expulsion of the trunk.

A familiarity not with the names of the various acts, but the things the names represent, is essential to the judicious prosecution of the obstetric art.

Descent and Flexion.—Descent and flexion go hand in hand, and should be associated in thought as they are in reality. It is evident, whenever the head encounters the resistance of the obstetric canal, the force transmitted through the spine to the foramen magnum will cause the descent of the occiput, and thus flexion will result. The degree of flexion, however, is proportioned to the extent of the action of the walls upon the frontal extremity of the head, and therefore is variable in different subjects and in different parts of the canal.

The head enters the pelvis in the axis of the brim with the biparietal diameter very nearly parallel to the superior strait. This direction it maintains until arrested by the curvature of the sacrum and by the floor of the pelvis.

The descent of the head through the cervix is effected by the pressure of the uterus during contraction upon its entire contents. Even admitting the possibility of a certain amount of propulsive energy from the uterine walls through the trunk of the child to the head, it is necessarily of feeble force, as the flexibility of the spine and the smoothness of the breech prevent the latter from finding a proper *point d'appui* against the vaulted fundus.

In the transit of the head through the cervix the degree of flexion is governed by the amount of pressure exerted by the cervical ring upon the frontal portion. In some instances this suffices to render flexion complete—i. e., the chin sinks until arrested by contact with the chest; whereas, as is most often the case in multiparæ, the cervix may be so softened and dilatable as to affect but slightly the direction of the occipito-frontal diameter. Most frequently the maximum degree of flexion is occasioned by the convergence of the walls of the parturient canal at the pelvic outlet. It is well for the beginner to keep constantly in mind that flexion is not in any sense an active movement. It is always a movement of accommodation, the end of which is the successive substitution of a shorter diameter for a previous longer one, so soon as the latter has encountered sufficient resistance to arrest its further progress. The mechanical advantages of flexion are obvious, when we recall that the average length of the sub-occipito-bregmatic

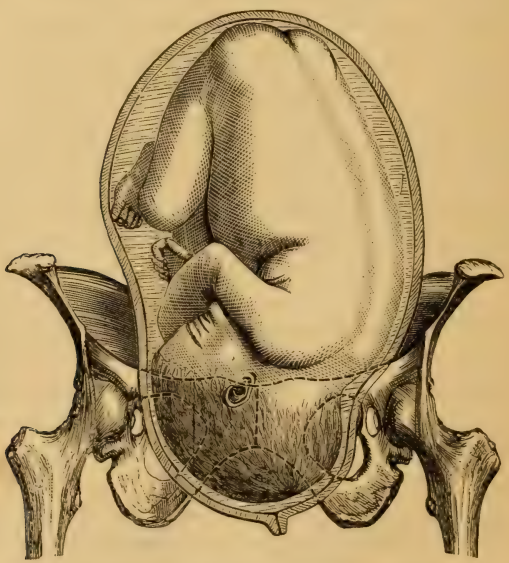


Fig. 99.—Vertex presentation; child surrounded by amniotic fluid. (Pinard.)

or maximum diameter of the flexed head ($3\frac{3}{4}$ inches) is three quarters of an inch less than the occipito-frontal or maximum diameter of the head when midway between extension and flexion. Again, the maximum circumference of the flexed head (thirteen inches) is $1\frac{3}{4}$ inch less than one measured about the extremities of the occipito-frontal diameter. These measurements, which are representative of the natural state, are, however, far from expressing the full extent of the differences which exist after the plastic head has undergone the molding processes incident to labor.

A further advantage of flexion is thus described by Professor Pajot: "The fœtus, in its entirety, is to be regarded as a broken, vacillating rod, possessed of mobility at the articulation of the head and trunk; but a solid thus disposed presents conditions unfavorable to the transmission of a force acting principally upon one of its extremities; it follows, therefore, that previous to flexion the uterine action, pressing upon the pelvic extremity to promote the advance of the fœtus, is lost in great measure in its passage from the trunk to the head by reason of the mobility of the latter; but the cephalic extremity, once fixed upon the thorax, is most advantageously disposed to participate in the impulse communicated to the general mass of the fœtus." *

After the head is once released from the environment of the cervical canal, a slight movement of extension may follow, provided the resistance offered by the vagina is less than that of the cervix. In many cases, as has been stated, where dilatation is complete at the time of rupture of the membranes, the head may pass through the cervix with scarcely any change in its direction, flexion taking place first when the head encounters the resistance of the sloping pelvic walls and the perineal floor.

Rotation.—The head, as we have seen, follows the axis of the superior strait until arrested by the extremity of the sacrum and the perineal floor. As it nears the latter, the curvature of the sacrum approximates the posterior wall to the sagittal suture. Upon vaginal examination, the finger comes in contact with the anterior half of the head as the presenting part. It is not, however, on that account to be assumed that the head is inclined laterally toward the posterior shoulder, though the sensation produced deceptively favors such a theory.†

When the head has once reached the perineal floor, its further progress is associated with the most interesting of the mechanical acts of labor. The occiput, whether previously directed to the anterior or posterior extremity of an oblique diameter, turns forward under the arch of the pubes, until the sagittal suture occupies very nearly the antero-posterior diameter of the outlet. The utility of this movement is obvious. Owing to the inward slope of the side walls of the pelvis, the distance between the ischia is but 4¼ inches, and between the spines 4 inches. If, in forceps operations, the head is dragged through the transverse diameter of the pelvis previous to rotation, it becomes flattened and lengthened in the direction of the trachelo-bregmatic diam-

* Pajot, Dictionnaire encyclopédique des sciences médicales, t. i, p. 382, quoted by Tarnier et Chantreuil, p. 639.

† With the apparent obliquity it is probable that a certain amount of real obliquity coexists. As, even in extreme flexion, the lateral movements of the head are not interfered with, it is hardly to be expected that the head, when arrested at the perineal floor, would continue to maintain a right line with the spine.

eter, and the child's life, and the soft parts of the mother, are jeopardized. When, however, rotation is completed, the bi-parietal diameter ($3\frac{3}{4}$ inches), which is capable of sustaining a considerable degree of lateral compression, engages in the transverse diameter of the pelvis; at the same time the sub-occipito-bregmatic engages in the conjugate diameter. The latter, though measuring but $3\frac{3}{4}$ inches, may be extended to $4\frac{1}{2}$ inches by the pressing backward of the tip of the coccyx.

The conditions for the forward rotation of the occiput are—1. Flexion; 2. Good labor-pains; 3. A firm perinæum.

In either of the occipito-anterior positions rotation is not difficult to understand. The convergent anterior inclined planes furnish smooth surfaces upon which the occiput glides downward and forward

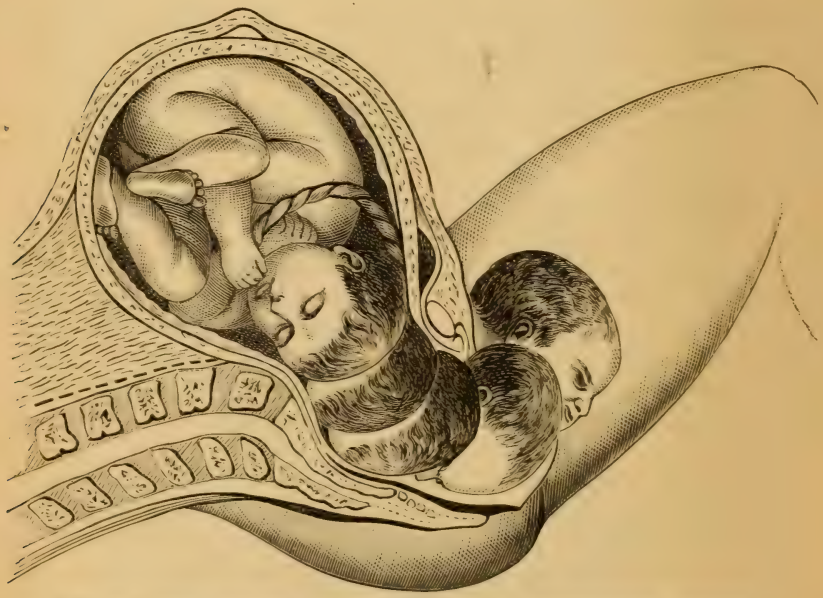


FIG. 100.—Figure illustrating the mechanism of labor in occipito-anterior deliveries. (After Schultze.)

to the front. The rigid ischial spines direct the forehead to the sacro-sciatic ligaments, which determine the backward movement corresponding to that of the occiput in the front part of the pelvis.*

* Prof. Henry G. Landis, in a most ingenious essay entitled How to use the Forceps, argues that, practically, the pelvis contains two canals, partially separate at the beginning and identical at their termination. The right canal is the one in which the right sacro-iliac articulation is found, and the left the one to which the left sacro-iliac articulation belongs. These canals converge from above downward, and are also mutually curved from before backward. Their direction is therefore spiral. The caliber of each canal is that of the fetal head: therefore, the head may descend in either canal, and will follow a spiral course in so doing.

Professor Pajot expresses the law which governs the rotation movements in the following terms: "When a solid body is contained within another, if the receptacle (*contenant*) is the seat of alternations of movement and repose, and its surfaces are slippery and but slightly angular, the contained body will tend increasingly to accommodate its form and dimensions to the form and capacity of the receptacle."*

In occipito-posterior positions, the rotation of the occiput forward is, at the first glance, a puzzling phenomenon, as the inclined planes of the pelvis, the ischial spines, and the law of accommodation, previously invoked by way of explanation, should determine the rotation of the occiput not to the front but to the sacral cavity. The following experiment of Dubois, however, throws considerable light upon the principal conditions of success: "In a woman who had died a short time previous in child-bed, the uterus, which had remained flaccid and of large size, was opened to the cervical orifice, and held by aids in a suitable position above the superior strait; the fœtus of the woman was then placed in the soft and dilated uterine orifice in the right occipito-posterior position. Several pupil-midwives, pushing the fœtus from above, readily caused it to enter the cavity of the pelvis; much greater effort was needed to make the head travel over the perinæum and clear the vulva; but it was not without astonishment that we saw, in three successive attempts, that when the head had traversed the external genital organs, the occiput had turned to the right anterior position, while the face had turned to the left and to the rear; in a word, rotation had taken place as in natural labor. We repeated the experiment a fourth time, but as the head cleared the vulva the occiput remained posterior. Then we took a dead-born fœtus of the previous night, but of much larger size than the preceding; we placed it in the same conditions as the first, and twice in succession witnessed the head clear the vulva after having executed the movement of rotation. Upon the third and following essays, delivery was accomplished without the occurrence of rotation; thus the movement only ceased after the perinæum and vulva had lost the resistance which had made it necessary, or, at least, had been the provoking cause of its accomplishment."†

This interesting experiment shows that it is unnecessary to assume a rotation force in the uterus itself. A certain amount of light is thrown upon the action of the perineal floor by the clinical fact that it is always the most dependent portion of the presenting part which rotates to the front. A moment's reflection will show that rotation, therefore, takes place in such a direction that the sloping surface of the child's head is brought into correspondence with the downward slope of the perinæum. Thus it sometimes happens, in occipito-pos-

* Martel, De l'accommodation en obstétrique, *vide* introduction.

† *Ibid.*, quotation, p. 93.

terior positions, that moderate extension occurs, so that the large fontanelle is felt below the plane of the small one. In this case, the head rests with its entire length upon the perineal floor; its movements are of necessity restrained within narrow limits; and, if extension persists, the pressure of the opposing ischio-pubic ramus directs the forehead under the arch of the pubes. When, however, the head is well flexed it no longer corresponds to the perineal plane. The occiput then glides downward, and is projected forward by the elastic pelvic floor until the anterior parietal boss is forced between the ischio-pubic rami. As the occipital end of the flexed head descends downward and forward toward the pubic arch, the frontal extremity encounters the resistance of the pelvic wall near the ileo-pectineal eminence. If the pressure upon the head were in all parts equal, no further progress would now be possible. But it is not equal. The backward pressure applied to the frontal portion of the head is exerted upon the long end of a lever, and works, therefore, at a greater mechanical advantage than that directed against the occiput.* At the same time, if the anterior wall be divided by a line drawn on a level with the lower margin of the symphysis, we find that in the superior division the general pelvic pressure diminishes from before backward, while below the line indicated, owing to the open space afforded by the pubic arch in front, pressure diminishes from behind forward. Now, in accordance with the mechanical principle that when a body is subjected to varying pressures the movement will take place in the direction of the least pressure,† we find that the frontal portion, which lies above the sub-pubic plane, turns backward, while the occiput, which lies below, turns under the arch of the pubis.

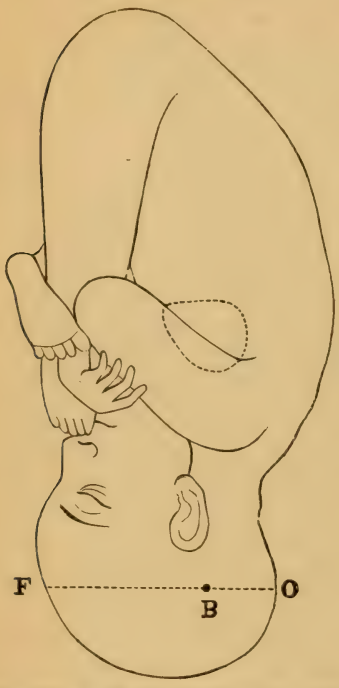


FIG. 101.—O, B, short end of the head lever; B, F, long end of head lever. (Tarnier et Chantreuil.)

It must not be supposed, in imagining the results of rotation, that the movement continues until exact coincidence of the sagittal suture and the conjugate is reached. Leishman endeavored to measure the

* TARNIER et CHANTREUIL, Traité de l'art des accouchements, p. 644.

† STEPHENSON, On the Mechanism of Labor, Obstet. Jour. of Gr. Brit. and Ire., October, 1878, p. 405.

divergence between the two after the head had escaped from under the pelvic arch, by stretching a cord over the surface of the head from the lower border of the symphysis to the coccyx. He found that in left occipital positions the cord crossed the lambdoidal suture about an inch to the right of the small fontanelle, and thence extended forward to the middle of the opposite orbit, intersecting the median line at or near the anterior fontanelle.*

In emerging from the pelvis, the two tubera parietalia do not pass out at the same time. In place of this, the head rolls upon its side, so that in left occipital positions the presentation is formed by the upper and posterior part of the right parietal bone, and in right occipital positions by the corresponding territory upon the left parietal bone.

Extension.—As the head clears the inferior strait it distends the perinæum, and converts it into a groove, which directs the occiput toward the vaginal orifice. With the descent of the head the perinæum lengthens; between the pains the perinæum retracts, and the head recedes. A gradual softening results from the continuance of this play, and, with diminished resistance from the perinæum, the occiput descends along the anterior pelvic wall, the trunk enters the cavity, and the neck finds support against the os pubis. Flexion continues until the occiput engages between the pubic rami. When the resistance of the anterior bony wall is no longer encountered, the surface of the child's head glides forward upon the perinæum, as upon an inclined plane, and describes a circle beneath the pelvic arch, of which the sub-occipito-bregmatic diameter forms the radius.

The extension of the head, which is an essential feature of the foregoing movement, is the resultant of two forces, derived, first, from the uterus, second, from the pelvic floor.

The uterine action is transmitted in the axis of the superior strait. With the occiput fixed beneath the pubic arch and the neck resting against the inner surface of the pubes, the propulsive force is expended upon the frontal extremity of the head, and this causes the separation of the chin from the thorax. So soon as the forehead passes the apex of the sacrum, the recoil of the coccyx and the elastic perinæum drives the fronto-occipital diameter forward to the vulva, which now looks in a nearly vertical direction. When the bi-parietal diameter has once passed the vaginal orifice, the perinæum rapidly retracts, and, as it glides over the face, the occiput is thrown sharply and rapidly upward against the pubes.

External Rotation.—After the birth of the head, the face, no longer supported by the perinæum, sinks toward the anal region. At the same time, or with the recurrence of a pain, the head makes a quarter-

* Leishman, The Mechanism of Parturition, p. 84. It will be readily understood, that in right occipital positions the cord should pass from the left of the small fontanelle forward to the right orbit.

rotation, the occiput turning toward the thigh corresponding to the side to which it was originally directed (right occipital position, right thigh; left occipital position, left thigh), and the face to the internal surface of the opposite thigh. This movement is partly a restitution of the head to its normal direction, and partly is due to a corresponding rotation of the shoulders in the pelvic cavity. To understand the mechanism of external rotation it must be borne in mind that, in the movement of rotation, performed by the head in its transit through the pelvic canal, the trunk participates to a diminished extent only. Thus, Schatz* found, in the frozen section made by Braune through the cadaver of a woman who died in the second stage of labor, where the head had originally occupied the right occipito-posterior position, that the deviation between the pelvic extremity and the head was measured by an angle of thirty degrees, and between the head and trunk, on a line with the shoulders, by an angle of thirteen degrees. After the release of the head from the vulva the torsion ceases, and the fetal parts resume their natural relations to one another. The head, therefore, turns slightly to the side, as it accommodates itself to the direction of the shoulders. This first movement is termed "restitution," and is much less marked in occipito-anterior than in occipito-posterior positions. The shoulders assume an oblique position, until, encountering the sloping pelvic planes, the anterior shoulder rotates forward, and the bis-acromial diameter approximates to the antero-posterior diameter of the outlet. The internal rotation of the shoulders usually takes place suddenly, and is accompanied by the corresponding movement of the child's head.

Excessive rotation is sometimes observed. Thus, the shoulders, in place of turning to the antero-postorior diameter, may continue in movement until they occupy the oblique diameter of the opposing side, the posterior shoulder coming to the front. This necessarily causes faulty external rotation of the head. It occurs most frequently in occipito-posterior positions.†

Expulsion of the Trunk.—After rotation, the anterior shoulder passes under the arch of the pubes; the trunk, as it is driven down from above, becomes bent laterally, and the posterior shoulder glides forward upon the perinæum to the commissure of the vulva; both shoulders then make the exit from the vaginal canal simultaneously. In the delivery of the shoulders the bis-acromial diameter is usually somewhat oblique. The expulsion of the trunk, owing to the previous dilatation of the passage, follows with rapidity; the body executes a spiral movement until the hips engage at the outlet; during the birth of the pelvis, however, the bis-iliac diameter rotates so as to approximate to the line extending from the coccyx to the pubes.

* Schatz, Arch. f. Gynaek., Bd. vi, p. 413.

† Dohrn, Ueber die Ursachen fehlerhaftes Drehung der Schultern, etc., Arch. f. Gynaek., Bd. iv, p. 363.

Abnormal Mechanism of Labor. (Vertex Presentation.)

In the proper performance of the various mechanical acts of labor, it is necessary that the diameters of the fetal head approximate to those of the canal through which it has to pass. A very large pelvis, or a very small head, may become disturbing factors by leading to imperfect flexion and rotation. In either case, with a lax perinæum and gaping vulva, the head may be born in any of the diameters of the pelvis. Head-births in either an oblique or transverse diameter are, however, extremely rare. They are attended with unusual difficulty, as the occiput has to traverse a longer course than when directed forward under the pubic arch.

The most important of the irregular forms results from the rotation of the occiput, in occipito-posterior positions, backward into the hollow of the sacrum.* The chief condition of its production is a partial extension of the head, the forehead then turning anteriorly, in accordance with the law that the most dependent portion of the presenting part is moved to the front.

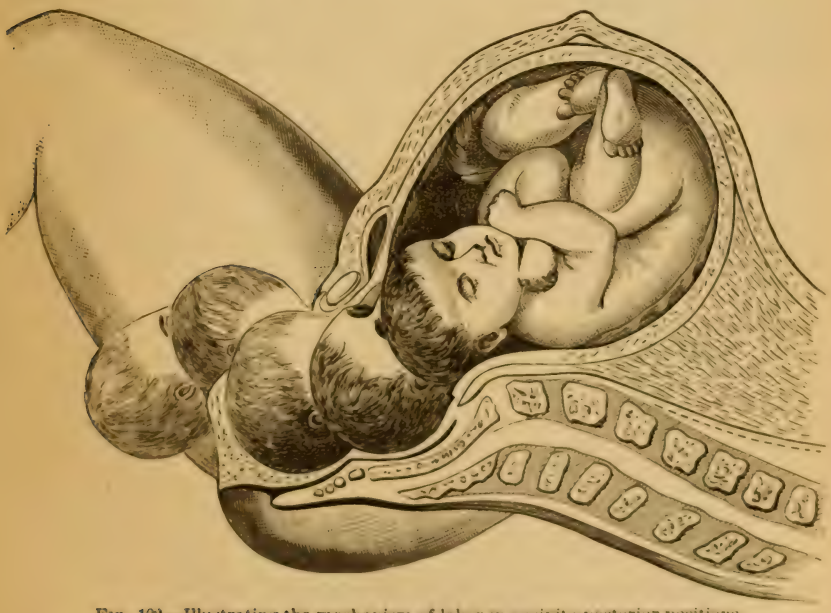


Fig. 102.—Illustrating the mechanism of labor in occipito-posterior positions. (After Schultze.)

The Mechanism of Occipito-posterior Positions.—When the occiput turns backward, it rests upon the anterior surface of the sacrum and

* Playfair states that Dr. Uvedale West found the frequency of this backward rotation was four times to the hundred in occipito-posterior positions. American edition, p. 265.

upon the perinæum; the forehead and the anterior fontanelle distend the vulva. If the rotation is incomplete, the anterior parietal, or adjacent frontal bones, are seen at the rima pudendi; and, as the frontal portion is born, the occiput sweeps forward to the perineal commissure. After the occiput makes its exit, the neck rests upon the perinæum, while the head swings backward, describing a circle, of which the sub-occipito-bregmatic diameter forms the radius.

Delivery in these cases is apt to be tedious, and often demands the aid of forceps.

Configuration of the Head in Vertex Presentations.

During labor the various head diameters of the fœtus undergo extensive modification as they are subjected to the resistance of the parturient canal. Of these, the most important is the diminution of the sub-occipito-bregmatic, the occipito-frontal, and the bi-temporal diameters, with compensatory elongation taking place in a line running from the chin to a point in the sagittal suture situated between the apex of the occipital bone and the large fontanelle (maximum diameter of Budin). The plastic changes mentioned are rendered possible by the presence of the fontanelles, the width of the sutures, the plia-

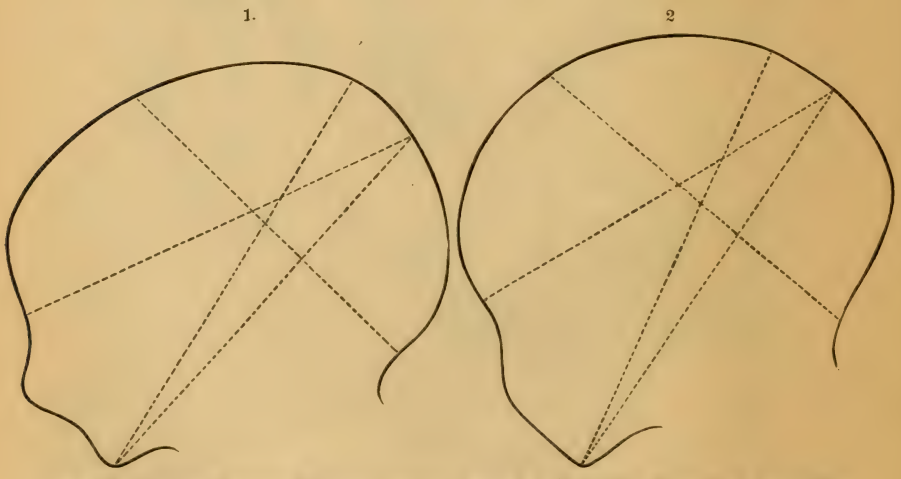


Fig. 103.—Outlines showing difference between head of child at birth (1) and four days subsequent to delivery (2). (Budin.)

bility of the sagittal borders of the parietal bones, the depressibility of the os frontis, and the joint-like movement between the squamous and basilar positions of the occipital bone. As a consequence of these anatomical dispositions, pressure from above inclines the frontal bones backward, while the resistance encountered below shoves the occipital bone in a forward direction. These movements are rendered possible

by the depression of both frontal and occipital bones beneath the adjacent borders of the parietal bones; at the same time, the dragging thus exerted upon the latter, front and rear, increases the curve of the cranial vault along the line of the sagittal suture. The sharpness of the bend at the summit of the curve is more or less pronounced, according to the rigidity of the channel through which the head passes. In cases of birth with the occiput to the rear, the head is often drawn out to a great length, the occiput forming an almost vertical line with the neck and shoulders, while in front the forehead and parietal bones slope upward to the vertex in nearly the same plane.

The contour of the head is still further modified by the formation of the caput succedaneum, or scalp-tumor, a swelling developing upon the portion of the presenting part, which is subjected to diminished pressure from the obstetric canal, and which in consequence becomes the seat of venous hyperæmia, œdema, and extravasation. The formation of the tumor is usually preceded by wrinkling of the scalp, indicative of the stronger compression above. It may be produced within the cervical canal, but is then usually of insignificant size and of small practical importance. Indeed, it may even form previous to rupture of the membranes in cases where the separation of the bag of waters from the contents of the uterine cavity is complete, and where, we have seen, the water-pressure below the line of cervical contact with the head is less than the intra-uterine pressure above. Usually, however, it is developed after the head reaches the pelvic floor, at the outlet of the vagina, the situation upon the scalp often enabling one subsequent to delivery to diagnose the position the head had occupied within the pelvic canal.*

FIG. 104.—Showing shape of head in occipito-posterior deliveries. (Tarnier et Chantreuil.)

A voluminous scalp-tumor is, as a rule, the result of compression from the bony canal, and forms, therefore, in normal pelves, below the narrowing of the inferior strait. In generally contracted pelves, however, where the resistance of the bony canal is encountered at the

* The tumor forms, in left occipito-anterior positions, upon the superior posterior angle of the right parietal bone, encroaching somewhat upon the small fontanelle and the occiput; in right occipito-anterior positions, upon the corresponding point on the left side of the cranium. In occipito-posterior deliveries the tumor develops upon the anterior superior angle of the parietal bone turned to the pubic arch, and encroaching upon the large fontanelle, and even upon the frontal suture. If the head-rotation is complete, and the head is detained for a long period at the vulva, the tumor may occupy the median line, and thus obscure the diagnosis.

brim, the formation of an enormous scalp-tumor may precede the entrance of the head into the pelvis.

According to Dessaut,* the scalp-tumor is usually of larger size when situated upon the anterior surface of the head, partly because of the greater laxity of the tissues, and partly because of the longer duration of labor when the forehead is directed to the front. Its length may vary from a half-inch to two inches or more. In extreme cases, where the labor has been prolonged, there is sometimes found, associated with the scalp-tumor, a separation of both the periosteum and the dura mater from the underlying segment of the cranium.

Diagnosis.—The diagnosis of cranial presentations by external palpation is usually not difficult. The head is recognized by its hardness,

FIG. 105.—Method of performing external palpation. (Pinard.)

its rounded form, its separation from the trunk by the neck, and the ease with which ballottement is produced. Sometimes, by pressure upon the cranial bones, a peculiar parchment-like crackle is elicited, which is perceptible even through the abdominal parietes.† The breech, on the contrary, is of uneven shape, of smaller size, and of

* TARNIER et CHANTREUIL, p. 686.

† FASBENDER, Monatsschr. f. Geburtsk., Bd. xxxiii, p. 435. Dr. P. F. Mundé has recently furnished an excellent *résumé* of the subject of diagnosis by external examination in an essay termed Obstetric Palpation.

softer consistence. The feet are found in close proximity. Ballottement is obscure on account of the broad connection between the breech and the trunk. Under favorable conditions the back presents upon one side of the uterus a broad, palpable surface without distinctive bony projections. The outline of the dorsal surface may be rendered more distinct by downward pressure exerted over the fundus upon the breech of the child. The position of the child is determined—1. By the fetal heart, which, except in face-presentations, is heard most distinctly over the dorsal surface; 2. By the direction of the feet, which are situated upon the abdominal side of the child.

Upon examination made per vaginam the head is felt as a hard, round, smooth body, characterized by the sutures and fontanelles, and sufficiently large to fill the space of the pelvis. Before the rupture of the membranes, investigations should be conducted in the intervals between the pains, i. e., while the membranes are lax and depressible. If the head is high, and retreats before the examining finger, it should be steadied by counter-pressure applied to the fundus uteri through the abdominal walls.

The sutures and fontanelles are best made out after rupture of the membranes. In passing the extremity of the index-finger backward over the cranium toward the sacrum, the sagittal suture is usually encountered. At the extremities of the sagittal suture the two fontanelles are perceived, distinguishable from one another by the differences in size and shape. In exceptional cases the extreme compression of the bones of the skull may render the large fontanelle scarcely recognizable; in others, again, the presence of membranous spaces in the line of the sagittal suture, fissures at the apex of the occipital bone, or the existence of ossa triquetra near the site of the small fontanelle, may cause perplexity, and lead to errors in the diagnosis of head positions. It is therefore well to bear in mind, as special marks of distinction, that the small fontanelle furnishes the meeting-point of three sutures, while four sutures meet at the large fontanelle.

The sagittal suture pursues a straight course, forming a right angle with the coronal and an obtuse angle with the lambda suture. Anteriorly it is continuous with the frontal suture; posteriorly it ends abruptly at the occipital bone. The lambda suture, which is the only one liable to be mistaken for the preceding, is distinguished by its curvilinear direction, by the greater thickness of the parietal borders, and by the depression of the occipital beneath the parietal bones.

When the sutures are masked by the presence of a large scalp-tumor, it is still possible in most cases to diagnose the position by pushing the finger up behind the symphysis pubis and feeling for the ear.

CHAPTER X.

MECHANISM OF LABOR.—(Continued.)

Face presentations.—Frequency.—Causes.—Mechanism.—Descent and extension.—Rotation.—Flexion.—External Rotation.—Abnormal mechanism.—Configuration of head.—Diagnosis.—Prognosis.—Treatment.—Brow presentations.—Breech presentations.—Causes.—Diagnosis.—Mechanism.—Irregular mechanism.—Configuration.—Prognosis.—Treatment.

Face Presentations.

In facial presentations, in place of the normal attitude of the fœtus, the chin is extended, the occiput is reflected against the neck, and the face with the frontal portion of the skull occupies the entrance to the pelvis. It is not a very common anomaly, having occurred, according to Pinard, 320 times in 81,711 confinements at the Maternité in Paris, or, in round numbers, once in 250 cases.*

Causes.—The causes of face presentations are imperfectly known. Clinical observation has, however, succeeded in connecting the extension of the head in the pelvic canal with a variety of predisposing conditions. To Ahlfeld † we are indebted for a collection of associated events derived from a careful analysis of well-observed cases. From these, the following are selected because of their more palpable connection with the phenomenon in question :

Separation of the chin from the chest, resulting from congenital enlargement of the thyroid gland; from increased size of the chest interfering with flexion; from stricture of the cervix about the neck of the child, the uterine walls adding to the circumference of the thorax; from the mobility of the fœtus, either because of its small size or from excess of amniotic fluid; from oblique positions of the child and of the uterus, especially in cases of rapid escape of the amniotic fluid; and from coiling of the cord around the head of the fœtus. Hecker ‡ lays great stress upon the shape of the child's head, and has endeavored to establish a connection between face presentations and unusual length of the occiput. To be sure, after birth in face presentations the hindhead is often found to nearly equal in length the anterior portion, and it is easy to see that, were such the case at the beginning of labor, the question of extension or flexion would always be in suspense; but, in most cases, the shape is the effect rather than the cause of the presentation. Still, Hecker and others have reported instances where the elongation, instead of proving temporary, persisted after delivery, and therefore, it was fair to assume, had existed as a pre-natal condition.

* Charpentier, Contributions à l'étude des présentations de la face, p. 15.

† Ahlfeld, Die Entstehung der Stirn- und Gesichtslagen.

‡ Hecker, Ueber die Schädelform bei Gesichtslagen.

The resistance encountered by the occiput, which converts partial into complete extension of the head, may be furnished by either the uterine or the pelvic walls.

Most writers ascribe great importance to oblique positions of the fœtus and of the uterus in the etiology of face presentations. In multiparæ, the former are not uncommon during pregnancy, the head then resting upon an iliac fossa. As a rule, however, the first pains straighten the fœtus, the narrowing of the uterus in its transverse diameter serving to press the breech toward the fundus and the head into the pelvis. So long as the back of the child is directed downward, the rectification would inevitably be followed by head-flexion. When, however, the back is turned toward the fundus, and the change to the vertical attitude is not readily effected, the pressure of the adjacent uterine wall may, during contraction, act in a special degree upon the occiput, and direct it backward toward the neck, while the forehead sinks forward into the brim of the pelvis. This movement is often temporary, and with the descent of the child the resistance encountered by the forehead may exceed that met with from the occiput, and thus in the end flexion may follow in the ordinary manner. If, however, the extension continues, a point is finally reached at which the propelling force is exerted specially in the direction of the chin, now converted into the short end of the lever, and the face presentation becomes complete. In the same way, extension may be produced when the occiput is arrested at the linea innominata, an accident most likely to occur in transverse narrowing of the pelvis, and, again, in flattened pelves when the bi-parietal diameter is arrested by the contracted conjugate. The mechanism of head-flexion may likewise be interfered with by a prolapsed extremity encroaching upon the pelvic space.

In lateral obliquity of the uterus, the curvature of the uterine canal favors the production of face presentations when the back of the child conforms to the convexity of the lower surface, as the propelling force, which is transmitted in the axis of the uterus, then passes along the anterior aspect of the fœtus, and increases the tendency of the forehead to descend.

While in vertex presentations the left dorsal positions are nearly three times as frequent as the right, in face presentations the difference is very small.* Both Duncan † and Schroeder ‡ ascribe this rela-

* Statistics are as yet not sufficiently numerous to determine the question as to which position actually occurs most frequently. Dubois and Désormeaux (Dictionnaire, in thirty volumes, p. 364) reported eighty-five cases. Of these, in forty-five the chin was turned to the right, while in thirty-eight it was directed to the left. Dr. A. Walther (Winckel's Berichte, Bd. iii. p. 212) reported from the Dresden Lying-in Institute thirty-one cases. Of these, the chin was turned to the left twenty-one times, to the right ten times.

† Duncan, Edinburgh Obstet. Trans., vol. ii. p. 108.

‡ Schroeder, Lehrbuch der Geburtshülfe, p. 182.

tive preponderance of face presentations with the chin directed to the left to the constancy of right lateral obliquity of the uterus.

Ahlfeld * mentions further that it is not infrequent for extension to take place within the pelvic cavity, the arrest of the occiput resulting from an unusual projection of the spines of the ischia.

The Mechanism of Face Presentations.

As in vertex presentations, the dorsum of the child may be turned to the right or to the left side. The position of the face is usually designated by the direction of the chin. We distinguish, therefore:

Right mento-iliac positions (chin to right ilium);

Left mento-iliac positions (chin to left ilium).

Most frequently the face occupies the right oblique diameter of the pelvis. The common positions are, therefore, the right mento-iliac posterior and the left mento-iliac anterior; still, it is by no means rare for the face to enter the pelvis transversely, probably because of the frequent association of face presentations with a narrowing of the conjugate.

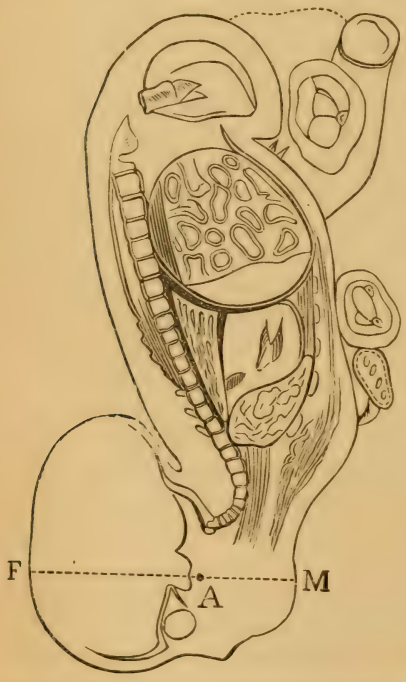


Fig. 106.—Attitude of the head in face presentations. (Ribémont.)

Descent and Extension.—These two movements, like descent and flexion in vertex presentations, are conjoined—not distinct from one another. At the brim, the large fontanelle is easily reached, while the chin is inaccessible. As the vertebral column is situated, in face presentations, nearer to the chin than the occiput, extension is accomplished in obedience to the same rules which produce flexion in vertex cases. With the descent of the head through the pelvic channel, the chin sinks deeper and deeper, while the occiput is pushed backward and pressed firmly against the dorsal surface of the child. The degree of extension at the different stages of the descent is measured by the relative positions of the chin and the large fontanelle.

The engagement of the head is usually slow and accomplished with

* Ahlfeld, *loc. cit.*, p. 62.

difficulty, owing to the fact that the neck and posterior portion of the head enter the excavation at the same time. The descent of the head is normally limited by the length of the child's neck, as it is only in the case of a very small child, or exceptionally roomy pelvis, that the head and upper portion of the thorax can enter the pelvis simultaneously.

When the face reaches the pelvic floor, a slight degree of lateral obliquity is produced, the cheek directed toward the pubes advancing somewhat more rapidly than the one turned to the sacrum.

Rotation.—When the chin has descended along the lateral or posterior wall of the pelvis until the thorax reaches the linea innominata, further progress is only rendered possible when the chin rotates forward and engages beneath the arch of the pubes. The mechanism of chin-

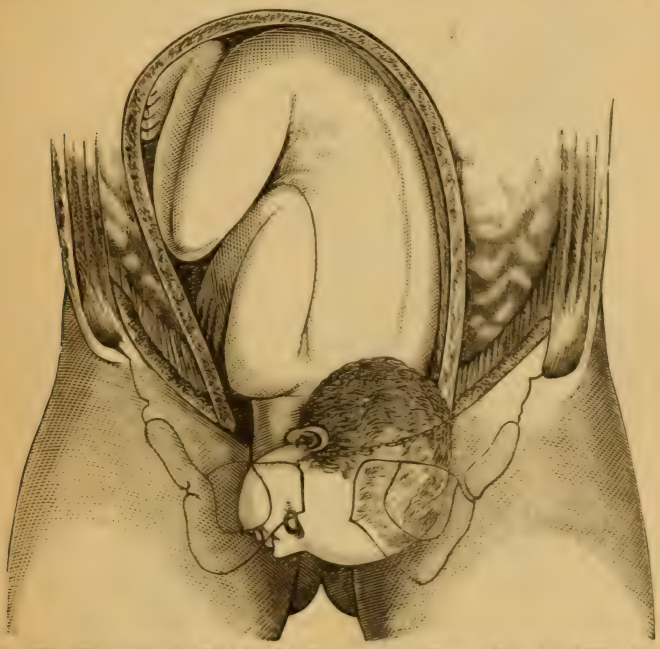


FIG. 107.—Engagement of the head in face presentations. (Tarnier et Chantreuil.)

rotation is the same portrayed in vertex presentations. When extension is complete, the chin, as the most dependent portion, glides downward and forward upon the perinæum, and the malar bone is pressed between the pubic rami. We have seen already that the pressure above the pubic arch diminishes from before backward, while below it diminishes from behind forward. In accordance with the mechanical principle, that a body subjected to varying pressures moves in the direction of least pressure, the chin or deeper portion turns to the front, while the cranial vault rotates into the hollow of the sacrum. To this movement the unequal length of the two extremities of the lever, measuring from

the malar bone to the top of the forehead on the one side, and from the malar bone to the chin upon the other, contributes in an important degree.*

Flexion.—After rotation, the chin emerges beneath the pubic arch, the shoulders press upon the base of the skull, the perinæum becomes rounded by the cranial vault, and, finally, as the head performs the movement of flexion in obedience to the forward impulse imparted by the perinæum, the chin rounds the symphysis, while the mouth, the nose, the brow, the vertex, and the occiput appear in succession at the posterior commissure of the vulva.

External Rotation.—When the delivery of the head is complete, the shoulders rotate into the antero-posterior diameter of the pelvis, the chin turning in correspondence, in right mento-iliac positions, to the right thigh; in left mento-iliac positions, to the left thigh.

Abnormal Mechanism.

In a fœtus of small size, the face may, when it meets with slight resistance from the perinæum, be borne in any of the pelvic diameters. Instances of spontaneous delivery without anterior rotation of the chin

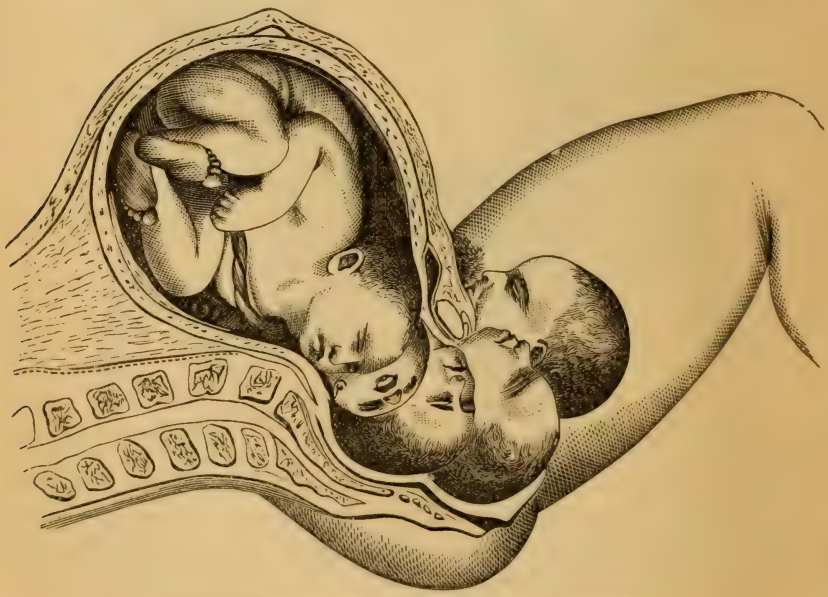


Fig. 108.—Mechanism of face presentations. (Schultze.)

are, however, extremely rare. The egress of the face in the transverse diameter is possible in a shallow, rachitic pelvis, flattened in the conjugate at the brim, and wide between the ischia at the outlet. The head

* Tarnier et Chantreuil, *loc. cit.*, p. 658.

emerges with the chin resting upon one of the ischio-pubic rami, around which the rotation of the mento-occipital diameter takes place. As the movement is associated with excessive stretching of the neck, it is evident that its execution is favored by the tensile condition of the tissues which follows death of the fœtus.

At full term, the face presenting, spontaneous delivery in mento-posterior positions is not practicable. This becomes evident when we reflect that, owing to the length of the sacral wall, the chin can not descend to the fourchette without an incredible flattening of the cranial

Fig. 109.—Face presentation, chin to the rear. (Hodge.)

vault and the simultaneous entrance of the chest into the pelvic cavity. It is claimed, however, that when the head is small and compressible it may stretch either the sacro-sciatic ligaments when oblique, or the perinæum after passing the extremity of the sacrum, to an extent sufficient to permit the descent of the occiput beneath the pubic arch, and the conversion of the face into a vertex-presentation.

Configuration of the Head in Face Presentations.

In face presentations the vault of the cranium is flattened, so that the sagittal suture runs from fontanelle to fontanelle in nearly a horizontal line; the squamous portion of the occipital bone is pushed backward, while in both the occipital and frontal bones the convexity is increased. As a result, there is an augmentation of the transverse, the occipito-frontal, and occipito-mental diameters, while the sub-occipito-bregmatic is diminished. The maximum diameter either corresponds

to the occipito-mental, or terminates posteriorly at a point below the apex of the occiput.*

The sero-sanguineous tumor, which forms upon the presenting part as a consequence of the diminished pressure, occupies the lower portion of the malar region, and the corner of the mouth (left mento-iliac position, left cheek; right mento-iliac position, right cheek) in mento-anterior positions, and the upper portion of the malar region, and even the eye, in mento-posterior positions. The integuments of the cheek assume a blackish-blue color; the tumefaction of the lids is such that at birth the eyes are closed, and sanguineous effusions are found upon the ocular conjunctiva; and the mouth, when involved, becomes swollen and distorted, so that suction is sometimes interfered with for several days after birth.

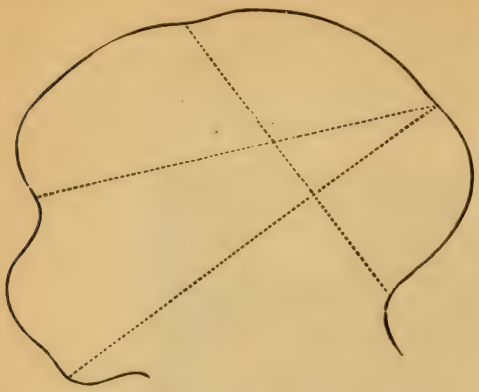


FIG. 110.—Outline of head born with face presenting.

Diagnosis.—At a time when a portion of the head still remains above the level of the pelvic brim, it is not infrequently possible to form a diagnosis from external manipulations alone. Thus, by making deep pressure with the tips of the fingers above the symphysis pubis, the cranium may, under favorable circumstances, be recognized upon one side of the pelvis, together with the sharp angle formed at the neck between the occiput and the dorsum of the fœtus. As the heart is heard with greatest distinctness over the anterior portion of the chest in face presentations, confirmatory evidence of the latter is afforded by detecting the presence of the fetal extremities, and the heart-sounds upon the

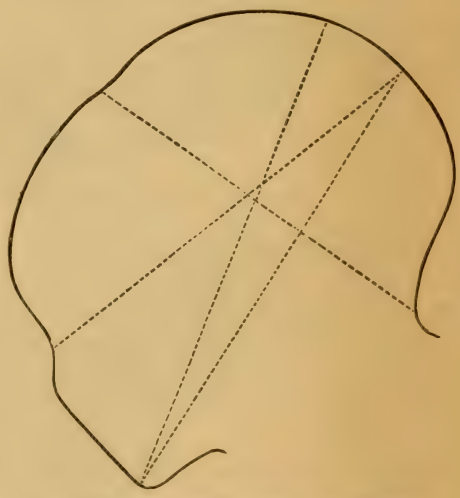


FIG. 111.—Same head five days later. (Budin.)

* BUDIN, *loc. cit.*, p. 77.

same, instead of, as in vertex presentations, upon opposite sides of the trunk.

Upon internal examination, the distinct peculiarities are a high position of the presenting part, a flattening of the vaginal fornix, and, through the intervening tissues, the recognition of the smooth forehead, contrasting with the uneven surface of the face. Through the dilated cervix the finger detects the forehead, the bridge of the nose, the nostrils, the orbits, the malar bones, the alveolar processes of the jaw, the mouth, and, when extension is complete, the pointed chin. Instances have, indeed, been recorded where, in advanced labor, the distorted face has been confounded with the breech, the inexperienced observer mistaking the swollen cheeks for the nates, the malar bones for the ischia, the nose for the tip of the coccyx, the œdematous eyelids for the scrotum, and the mouth for the anus. Such an error is best avoided by deliberation in exploring the presenting part. With proper care the smooth forehead, the bridge of the nose, the hard orbital borders, the chin, and especially the mouth, through which the jaws can be felt, afford sufficient data for a correct diagnosis.

Prognosis.—According to the statistics of Winckel,* the mortality of the children in face presentations amounted to thirteen per cent, while that of the mothers reached as high as six per cent. Thus, though spontaneous delivery is the rule in face presentations, the dangers to both mother and child are considerably greater than in vertex presentations. The causes of the less favorable prognosis are to be looked for in the increased peripheral head measurements, which engage successively in the different planes of the obstetric canal, and consequently from the increased reciprocal pressure exerted between the head and the soft parts, and partly from the compression of the veins of the neck by the anterior wall of the pelvis. Though the average length of labor does not much exceed that of normal presentations,† the duration is more readily affected by minor disturbances, such as weak pains, moderately contracted pelves, and rigidity of the obstetric canal. At the same time, the prolongation of labor in these cases is attended by more disastrous consequences, and calls more frequently for the resources of art to complete the delivery.

Treatment.—The first rule in the treatment of face presentations is to carefully avoid prematurely rupturing the membranes. The face is ill adapted to serve the purpose of a dilator to the cervical canal, and early rupture is apt to be followed by complete escape of the amniotic fluid—an accident always to be dreaded, but specially serious in face-presentations, where the umbilical cord is exposed to pressure between the anterior surface of the child and the uterine wall. Examinations made with a view to diagnosis should therefore be conducted with

* Winckel, Pathologie der Geburtshülfe, p. 89.

† Walther, Winckel's Berichte, Bd. iii, p. 315.

great care, during an interval between the pains, and their repetition should be avoided when the requisite information has once been obtained. During the progress of the first stage of labor, it is recommended to place the mother upon the side toward which the chin of the child is turned, with a view of favoring extension and rotation.

Because of the uncertainties of the prognosis in face presentations, many manœuvres have been proposed for the conversion of the latter into normal presentations. The manipulations chiefly recommended consist of either pushing up the face or drawing down the occiput, with the fingers passed through the cervical canal. Though occasionally successful, they have been discountenanced at least in mento-anterior positions by most obstetric writers, because experience has shown the results to be by no means commensurate with the dangers incurred. Schatz* has, however, suggested a rational plan for reducing the extended head by external manipulations only, which avoids the objections to the earlier methods. His manœuvre consists in restoring the normal attitude of the body by flexing the trunk, and leaving the head to resume spontaneously its proper position as it sinks into the pelvis. It is performed by seizing the shoulder and breast with the hand through the abdominal walls; then lifting the chest upward and pressing it backward, at the same time steadying or raising the breech with the other hand applied near the fundus, so as to make the long axis of

FIGS. 112–114.—Diagram showing Schatz's method of converting face presentations into vertex presentations.

the child conform to that of the uterus, and, finally, pressing the breech directly downward. As the child is raised, the occiput is allowed to descend, and then, as the body is bent forward, head-flexion is produced by the resistance of the side walls of the pelvis. Schatz illus-

* SCHATZ, Die Umwandlung von Gesichtslage, etc., Arch. f. Gynaek., Bd. v, p. 313.

trates these movements by the accompanying diagrams. If, owing to its elevation, the head tends to move to one side when backward pressure is made upon the chest, the place of the pelvic wall may be supplied by external pressure exerted by an assistant. The time for attempting this manipulation is previous to the rupture of the membranes. The requisites for success are experience in mapping out the fetal outlines by external palpation, and the absence of abdominal and uterine irritability. After rupture of the membranes, great care must be exercised in vaginal explorations, to avoid injuring the eyes or exciting premature respiratory movements by allowing air to enter the mouth.

If the chin remains persistently directed to the rear, rotation may sometimes be promoted by either pressing forward with two fingers upon the lower jaw, or by pushing the forehead backward and upward, to produce a deep descent of the chin. To be effective, either manipulation should be executed during a pain. Hodge advocates the vectis, and others a blade of the forceps, as of use in correcting mento-posterior positions. As a rule, however, good pains and complete extension are the conditions most likely to effect the forward movement of the chin. It is practically of importance to bear in mind that tardy rotation is characteristic of face presentations. If, however, the face remains persistently turned to the rear, before resorting to craniotomy, an attempt to produce head flexion by Baudelocque's method is admissible. This consists in making upward pressure with two fingers —first upon the chin, and then in succession upon the fossæ caninæ and upon the brow. Ziegenspeck * has recently reported a case where interference was delayed until uterine rupture threatened, in which he succeeded in flexing the head by combining the method of Baudelocque with that of Schatz. By the latter, an assistant succeeded in raising the brow to the level of the pelvic brim, while Ziegenspeck used pressure through the abdominal walls upon the occiput, and with the internal hand upon the face, until a vertex presentation was effected. The child was born living, and the mother made a good recovery. The treatment, in cases where all measures prove ineffective to secure a favorable change of position, and dangers accrue from delay to either mother or child, belongs to the domain of operative midwifery.

During head-expulsion caution must be used in supporting the perinæum, in order not to injure the neck by too strong forward pressure against the anterior wall of the pelvis.

It is safe to assure the bystanders that the distortion of the face and the extension of the head after delivery will disappear spontaneously in the course of from twenty-four to forty-eight hours.

* Ziegenspeck, Beitrag zur Behandlung der Gesichtslagen klinische Vorträge, No. 284.

Brow Presentations.

In brow presentations the head occupies a position intermediate between flexion and extension. Of necessity every face presentation has become such after first passing through the frontal stage. A temporary dip of the large fontanelle in the earlier period of labor is by no means uncommon. With the advance of the head, however, the resistance encountered usually causes the complete descent of either the chin or the occiput. The causes of brow presentations are, in the main, the same as those given for presentations of the face, viz., obliquity of the uterus and fœtus, enlargements of the neck and thorax, contracted pelvis, excessive mobility of the fœtus, and partial cervical stricture.

The diagnosis is made by recognizing the apex of the forehead in the pelvic canal, with the orbits and the root of the nose upon one side, and the large fontanelle and parietal bones upon the other. At the brim the frontal suture is usually transverse, but becomes oblique in its progress toward the pelvic outlet.

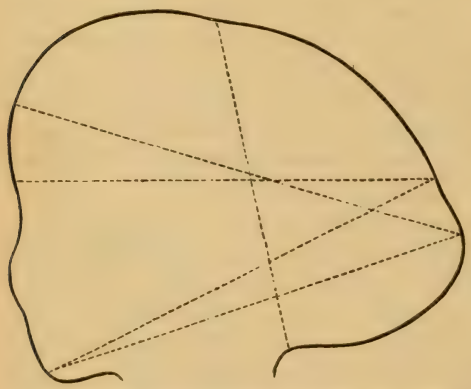


Fig. 115.—Outline of head after delivery, the brow presenting. (Budin.)

A small head may pass through a roomy pelvis, the brow presenting, without injury to either mother or child. In the mechanism of delivery the forehead turns to the front and appears at the vulva, the upper maxilla resting against the symphysis and the cranium lying in the hollow of the sacrum and upon the perinæum. The exit is accomplished by the cranial vault first sweeping forward over the perinæum; the upper jaw, the mouth, and the chin afterward making their appearance beneath the symphysis pubis.

Sometimes, though usually only when the forceps is used, the head may be delivered in the transverse diameter. In spontaneous cases the superior maxilla finds a point of support against one ischiopubic ramus, while the cranium rotates transversely through the vulva. When the face turns posteriorly, delivery of a living child is scarcely possible.

The configuration of the head is very striking. The swelling of the integuments extends from the root of the nose to the upper angle of the large fontanelle. The forehead is nearly perpendicular, while the parietal and occipital bones form a slope which inclines downward and backward. The mento-frontal and sub-occipito-frontal diameters

are increased, while the distance between the chin and a point in the sagittal suture anterior to the occiput is diminished. These changes impart to the head a triangular shape. The peculiar formation is explained by the compression of the occiput between the pelvis and the dorsal surface of the child, and the compensatory elongation which takes place in the direction of the forehead.

The prognosis is less favorable than in vertex presentations, but is by no means so sinister as is popularly supposed. Many cases of origi-

Fig. 116.—Brow presentation, subsequently converted into that of the face.* (Maternity Hospital.)

nal brow presentations become converted into face or vertex presentations during the progress of labor; many are delivered spontaneously, or by the aid of the forceps. Craniotomy is rarely called for.

Ahlfeld (Die Entstehung Steiss- und Gesichtslagen) furnishes twenty-six cases in which the result to both mother and child is given. Fritsch (Klinik der alltäglichen geburtshülflichen Operationen, p. 46) gives the histories of seven cases, and Budin (Tête du Fœtus, p. 53) the history of one case. In the thirty-four deliveries there were two maternal deaths; in one of the fatal cases coxalgic oblique pelvis existed as a complication. In the other the brow spontaneously changed into a face presentation. There were ten spontaneous deliveries, the brow presenting, with four dead children, but one died previous to labor. There were ten cases of spontaneous delivery in which the brow during delivery became converted into either a face or vertex presentation. Of these, one child died. Fourteen children were extracted with the forceps, nine with the brow presenting, of which two were dead, one from prolapsed funis, and

* Recovery of both mother and child. (From drawing of A. H. Fridenberg).

one which had died before labor; five, after conversion into face or vertex presentations, with no deaths. Thus, of the thirty-four children there were seven deaths, but of these four only could be attributed to the presentation.

From the foregoing, it is evident that the duties of the accoucheur, in the presence of brow presentation, should be confined to efforts to direct the labor to a favorable termination by one of the paths indicated by Nature. At the brim, previous to engagement, the dip of the anterior fontanelle is often temporary, in many cases simply signifying a narrowing in the upper conjugate. Version, therefore, so frequently recommended with a view to the substitution of diameters more conformable to those of the pelvis, should be limited to cases where the head is retained at the contracted conjugate, where the faulty position is due to cervical stricture (Bayer), and where speedy delivery is demanded in the interest of either mother or child.

Manual attempts to convert a brow presentation into one of the face or vertex possess more legitimate claims to favor. The method of Baudelocque consists in seizing the head with the entire hand introduced into the vagina, lifting it to the brim, and then drawing the occiput downward with the fingers until flexion becomes complete. The procedure was bitterly opposed by Chailly,* who urged against it, in addition to the frequency of failure, the dangers of uterine rupture, of prolapse of the cord, and the inconveniences arising from the early evacuation of the amniotic fluid. There is no question of success by this measure, and, if care is exercised, the concurrent risks are hardly sufficient to furnish contra-indications. At any rate, it would be proper to make the attempt when brow presentations complicate delivery in justo-minor pelvis, or in persistent mento-posterior positions, as in these cases craniotomy is the only alternative. Complete anæsthesia facilitates reduction. While elevating the head, firm counter-pressure should be made at the fundus uteri.†

Occasionally the conversion of the brow into a vertex or face presentation may be effected by pressure exerted during a pain upon respectively the occipital or frontal extremity of the head. In bringing down the vertex, the movement should be aided by external pressure made with the disengaged hand above the brim of the pelvis. When a face presentation is desired, the woman should be made to lie during labor upon the side to which the child's abdomen is directed, and upon the side to which the back is turned when the descent of the vertex is aimed at.

Schatz‡ recommends, with the view to the production of a face

* Chailly-Honoré, Traité pratique des accouchements, p. 783.

† *Vide* Parry, On the Use of the Hand to correct Unfavorable Presentations, etc., Am. Jour. of Obstet., vol. viii, p. 138.

‡ Schatz, Die Umwandlung von Gesichtslage zu Hinterhauptslage, etc., Arch. f. Gynaek., Bd. v, p. 328.

presentation, the introduction of two fingers into the child's mouth, and making traction on the superior maxilla.

When the head shows a disposition to revert to its original position so soon as pressure or traction is suspended, the forceps should be applied, and traction made in such a manner after reposition as to hold the head in the direction sought for.

In case the brow presentation is irreducible, the labor should be allowed to continue as long as compatible with the safety of the mother. Owing to its plasticity, the head often adapts itself in the most surprising manner to the unfavorable diameters of the pelvis, so that, even when spontaneous delivery fails to take place, the forceps become available. In mento-posterior positions, efforts should be made with the fingers, or the vectis, to rotate the chin forward. In fixed mento-posterior positions, the use of the forceps is impossible, and the conversion of the brow into a face presentation does not lessen the mechanical difficulties of delivery. The only artifice by which the life of the child can be saved consists in bringing down the occiput and producing a vertex presentation. Failing in this manœuvre, craniotomy becomes inevitable. In all cases of brow presentation, if the child is dead, craniotomy is indicated in the interest of the mother.

Breech Presentations.

In breech presentations the attitude of the child is primarily the same as in those of the vertex, though, owing to a variety of causes, such as voluntary or reflex movements and the action of gravity, especially after rupture of the membranes, the extremities may advance in front of the breech, and give rise secondarily to presentations of the foot or knee. Sometimes one extremity may become prolapsed, while the other is retained in its normal position; again, it may happen that, after the rupture of the membranes, the feet, which had previously been in close proximity to the breech, are pushed upward, so that the limbs become extended parallel to the anterior surface of the child's body. None of these changes, however, materially affect the mechanism of delivery.

Pinard * found, in 100,000 cases of confinement, 3,301 presentations by the breech, or in the proportion of one to thirty; but excluding premature births, the proportion was reduced to one in sixty-two.

Causes.—The causes of breech presentations are to be sought for mainly in the absence of the conditions which ordinarily determine the presentations of the head, or which interfere with the fixation of the fœtus. Thus, the production of breech presentations is favored by an excess of amniotic fluid, by lax uterine walls, and by contractions of the pelvis. They are more common in multiparæ than in primiparæ. Of the 3,301 cases collected by Pinard, there were 1,347 primiparæ and

* Tarnier et Chantreuil, Traité de l'art des ac., p. 454.

1,954 multiparæ, though the entire number was nearly equally divided between the two classes.* Finally, they occur with greatest frequency of all in twin pregnancies, and during the expulsion of premature and dead children. Of 32,264 children from the statistics of Hegar and Spiegelberg,† 910 were the product of multiple pregnancies, and 659

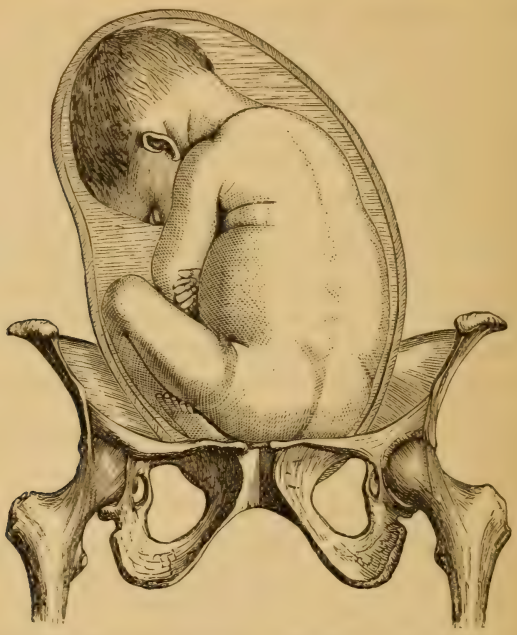


Fig. 117.—Presentation of the breech. Left dorso-anterior position. (Pinard.)

were premature. Of the former, 227, or 25 per cent, and of the latter, 148, or 224 per cent, were delivered by the breech, though we have seen that the ratio of breech presentations to the entire number of births does not exceed the proportion of one to thirty.

Diagnosis.—By external palpation the recognition of the head at the fundus uteri furnishes the chief diagnostic sign. Upon vaginal examination, the presenting part, as in face presentations, is usually high up, and reached with difficulty. The bag of membranes is apt to be of large size, owing to the imperfect closure of the lower uterine segment by the small breech, often descending through the canal, where the cervix is rigid, in the form of an elongated pouch. Through the membranes, upon pressing the fœtus downward during the interval between the pains, the breech is felt as a soft, irregular body, and with care it is possible to recognize the coccyx, the sacrum, the ilia, and sometimes to feel tapping movements from the feet. After rupture, the nates, the cleft between the nates, in boys the scrotum,

* *Vide* Tarnier et Chantreuil, p. 455. † Spiegelberg, *loc. cit.*, p. 171.

the anus, the feet when accessible, the coccyx, the sacrum, and the ilia, furnish the necessary data for an exact diagnosis. The pressure of the uterus upon the breech frequently occasions an evacuation of meconium. The latter is thick and consistent, thereby differing from the meconium passed in vertex cases by a dying fœtus, which is ordinarily thin from admixture of amniotic fluid. When the nates are much swollen they may be confounded with the cheeks in a face presentation—an error, however, easy to avoid, if the examination be made with deliberation, and the principal points of difference between breech and face already given (*vide* "Face Presentations," p. 191) are borne in mind.

The foot, as compared with the hand, is longer and narrower; the toes are shorter, of nearly equal length, and continuous in a straight line with the sole; the ankle-joint is less flexible than the wrist, and is distinguished by the malleoli and the pointed heel. As the outer border of the foot is thin and rounded, while the inner edge is thick and hollowed, it becomes possible to recognize which of the feet is under examination.

The knee is distinguished from the elbow by its larger size, by the patella, and by the spine of the tibia.

The Mechanism of Breech Presentations.—The position in breech presentations is defined by the direction of the back. Thus, we have right and left dorsal positions. Usually the hips occupy one of the oblique diameters of the pelvis. According, therefore, as the back is turned anteriorly or posteriorly, we distinguish right and left dorso-anterior and dorso-posterior positions.

The cervix dilates slowly, especially when the feet are in close proximity to the breech and increase the bulk of the presenting part. The latter is pressed downward into the pelvis until the perineal floor is reached. Here, owing to the shortness of the pubic wall, the anterior hip is felt with great distinctness, while the cleft of the nates lies near the curved sacrum. These anatomical relations give rise to the impression of an exaggerated degree of lateral obliquity. At the perinæum the breech glides forward and rotates upon its long axis, so that the bis-iliac diameter nearly corresponds to the lower conjugate. In the movement of rotation, it is always the anterior-lying hip, irrespective of the position of the trunk, which moves to the front. At the outlet one hip engages beneath the arch of the pubes, the other rests upon the coccyx and perinæum, while the sacrum is directed toward the tuber ischii. As the shoulders enter the pelvis in an oblique diameter, the trunk of the child becomes somewhat twisted by the rotation of the breech. The anterior buttock makes its appearance at the vulva, while the posterior distends the perinæum. As rotation is rarely complete, the forward trochanter usually finds its point of support against the nearest ischio-pubic ramus. During the advance of

the breech the lumbar region undergoes a certain amount of lateral flexion, owing to the forward movement imparted to the posterior hip by the coccyx and elastic perinæum. The degree of flexion is, however, limited by the rigidity of the lumbar portion of the vertebral

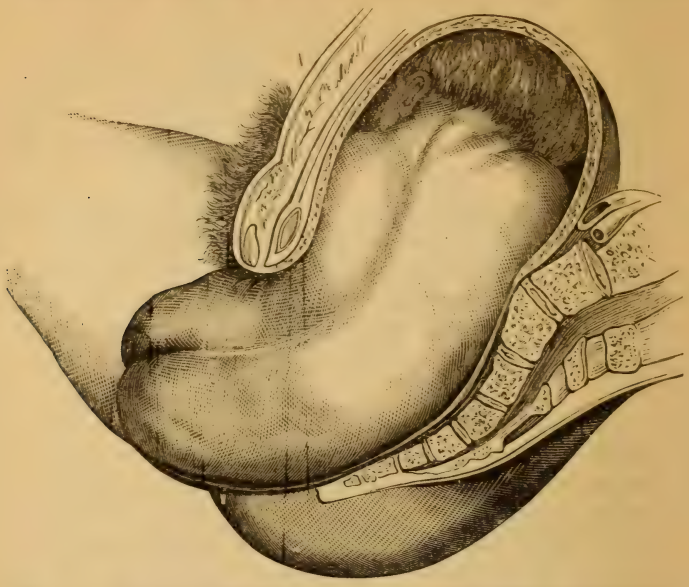


Fig. 118.—Showing lateral inflexion of the trunk during delivery of the breech.

column. When the posterior trochanter reaches the commissure of the vulva, the perinæum retracts, and in gliding backward directs the breech still farther to the front.

After delivery, the breech rotates into the oblique diameter it had originally occupied, this external rotation bringing the transverse diameter of the hips into correspondence with that of the shoulders. The uterine contractions continuing, the abdomen and base of the thorax slowly make their appearance; the thighs are then delivered, and the arms, folded upon the upper portion of the thorax, emerge from the vulva. The shoulders, which enter the pelvis in an oblique diameter, are delivered in the conjugate, the anterior shoulder resting beneath the pubic arch, while the posterior shoulder sweeps over the perinæum.

The head enters the pelvis in an oblique diameter, with the chin flexed upon the thorax. The expulsive efforts as the chin reaches the perinæum are followed by the rotation of the occiput to the pubes, and of the face into the hollow of the sacrum. At the outlet the neck is supported by the arch of the pubes, the face rests upon the perinæum, and the large fontanelle is felt at the coccyx. Under the influence of pressure from the abdomen, the brow sinks deeper and deeper, and is

pushed by the soft parts of the pelvic floor still closer to the thorax. The occiput then revolves beneath the pubic arch, and the chin, the mouth, the nose, the brow, the large fontanelle, and finally the occiput, appear in succession at the commissure of the vulva.

Irregularities in the Mechanism of Breech Presentations.—Though it is by no means rare for the breech to enter the pelvis with the sacrum turned to the sacro-iliac synchondrosis, the rotation, begun with the passage of the hips through the vulva, usually continues in the same direction until the back revolves to the front; or, after a first slight retrograde movement, the rotation forward takes place as the shoulders engage at the outlet. Still, cases do sometimes occur in which the back remains posterior during the whole period occupied by the expulsion of the trunk, and in which, consequently, the head enters the pelvis with the face directed to the pubes. Even here, however, it is very common for the occiput to eventually rotate forward, and for delivery to follow in the ordinary manner. Should, on the contrary,

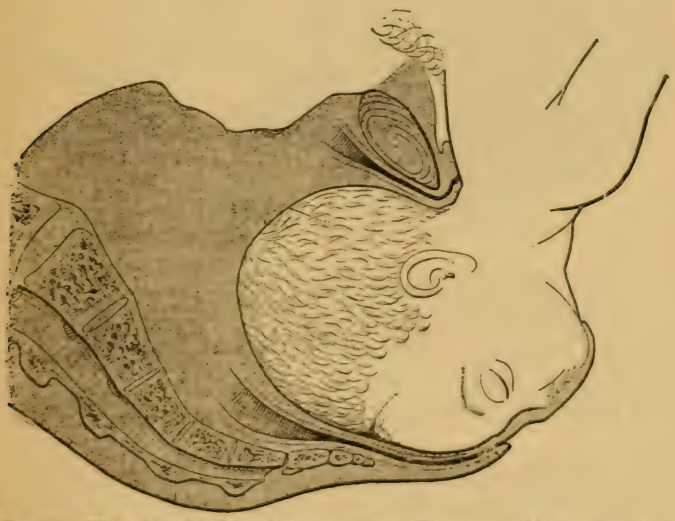


Fig. 119.—Exit of head in breech presentations. Face covered by perinæum. (Farabœuf and Varnier.)

the occiput remain in the hollow of the sacrum, spontaneous delivery may occur in either of two ways: 1. When no tractions have been made upon the extremities, the head reaches the outlet with the chin well flexed, the neck resting upon the commissure of the vulva, and the brow braced against the arch of the pubes. The birth of the head is then accomplished, as the neck pushes back the perinæum, by the successive descent of the face, the cranial vault, and the occiput. With a rigid perinæum, or an immovable coccyx, owing to the considerable degree of flexion which this movement necessitates, unaided delivery

may be rendered impossible. 2. If, during the transit of the head through the pelvis, extension occurs, the chin may be arrested at or above the symphysis pubis. In this position pressure from above pushes back the brow, so that the face looks upward, and the occiput is turned to the bottom of the pelvic excavation. During delivery the occiput glides over the perinæum to the fourchette, and the small fon-

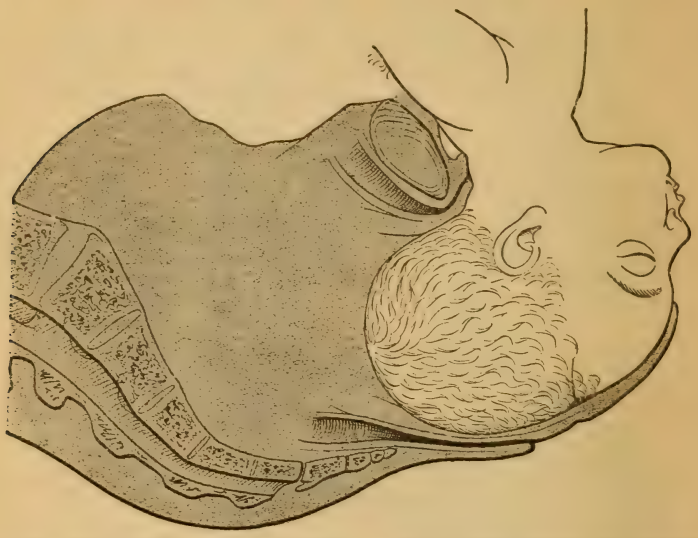


Fig. 120.—Exit of head in breech presentations. Face has emerged from the perinæum.

tanelle, the cranial vault, and the face escape in succession through the vulva. It is only possible for this method of delivery to take place spontaneously when either the head is small or the pelvis roomy, and the soft parts are devoid of rigidity. In artificial extraction of the head, it is proper to bear in mind and to imitate the natural order in expulsion.

In presentations of the foot and knee, the breech, if of small size, may pass the vulva in an oblique or transverse diameter, rotation following later during the passage of the trunk.

Excessive rotation is not uncommon, both head and trunk sometimes describing a half-circle. This occurrence is most frequently observed in cases where the posterior extremity presents, while the anterior buttock is caught above the pubic wall, the prolapsed limb then rotating, as a rule, to the front.*

The Configuration of the Fœtus in Breech Deliveries.—During the descent of the child through the genital canal, more or less swelling is developed upon that portion of the presenting part which is subjected to diminished pressure. This swelling varies, according to the dura-

* *Vide* Küstner, Die Steiss- und Fusslagen, p. 21.

tion of labor, from a slight œdema to a large, intensely discolored tumor. It is usually seated upon the anterior buttock, but often invades the genital organs, especially the scrotum, which at birth may present a bluish-black color, and be of double the usual size. The extremities, when near the breech, may also show signs of discoloration.

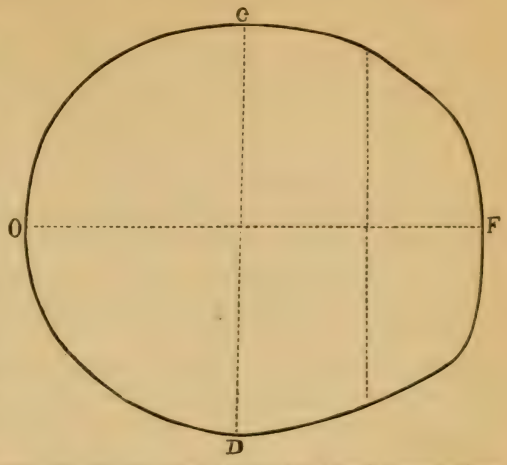


FIG. 121.—Showing shape of head in breech presentations. (Budin.)

The head has usually a characteristic round shape. This is due, according to Spiegelberg,* to the pressure exerted by the genital canal upon the circumference of the head, while at the same time, with the absence of pressure from above, there is produced an increase in the convexity of the cranial vault. Two cases reported by Hecker,† in which the length of the occiput was comparable to that found in face presentations, show, however, that the original shape of the head counts for something in the appearances presented after delivery.

Prognosis.—As regards the mother, the prognosis in uncomplicated cases does not differ materially from that of vertex cases. Where manual extraction becomes necessary, there is always, however, increased danger of lacerating—1, the cervix; 2, the perinæum.

Lacerations are apt to follow attempts to drag the after-coming head through an imperfectly dilated cervix. The prognosis is more favorable, therefore, in cases where the membranes do not rupture until after dilatation is completed. It is also better in pelvic presentations, where the bulk of the breech is increased by the addition of the extremities. In footling cases, when the membranes rupture prematurely, the smaller size of the pelvis and its rapid descent through the cervix imperfectly prepare the way for the subsequent passage of the head. A stricture is therefore liable to form about the neck of the child, and, as the spasm does not yield to force, the result of violent tractions is to sacrifice the integrity of the cervix, the extent of the laceration being proportioned to the power exerted.

Lacerations of the perinæum occur where with rigidity of the tissues it becomes necessary to introduce the hand to release the

* SPIEGELBERG, *loc. cit.*, p. 176.

† HECKER, Arch. f. Gynæk., Bd. xi, p. 348.

arms, or the interest of the child demands the speedy delivery of the head.

The prognosis for the child is, on the other hand, extremely unfavorable. According to the statistics of Dubois,* the mortality in full-term children is as one to eleven, while in vertex presentations the proportion is as one to fifty. The chief cause of this large death-rate is the pressure to which the cord is subjected between the child and the surface of the utero-vaginal canal, especially after the navel appears at the vulva. The pressure is exerted principally at the orifices of the uterus and the vagina, and is raised to the point of greatest danger after the head has become engaged in the pelvis. Other sources of peril arise from prolapse of the funis and the coiling of the latter around the body of the child, and from the complete escape of the amniotic fluid in premature rupture of the membranes.

Treatment.—Early in labor, with the membranes intact, it is desirable, in consideration of the unfavorable prognosis for the child, to try and perform cephalic version by external manipulations. In case of failure to bring down the head, care should be taken to preserve the membranes until dilatation is completed. To this end unnecessary examinations should be avoided; the patient should be placed upon her side, and cautioned not to strain; and when the membranes tend to form an elongated pouch, counter-pressure may be employed by means of a moderately distended Barnes's dilator introduced into the vagina. After rupture of the membranes it is best to remain passive. In the interest of the child, it is desirable that the expulsion of the trunk should take place slowly. Bringing down an extremity, as a prophylactic measure in order to secure a good handle in case of subsequent delay, is a questionable procedure. By this manœuvre a path is opened for the descent of the cord, and the mechanism of delivery is disturbed. When the hips appear at the vulva, the attending physician should be ready to extract in case of emergency. The patient should, therefore, if lying upon the left side, be brought near the edge of the bed; if upon the back, she should be placed across the bed, with the hips well over the edge. She should be instructed to bear down during the pains. The lateral flexion of the lumbar portion of the trunk should be sustained by the hand applied to the perinæum. The trunk, as it advances through the vulva, should be wrapped in a warm cloth and raised upward. When the cord appears, it should be drawn gently downward in the direction of one of the recesses to the side of the promontory; in case the cord passes between the thighs of the child, it should be released by slipping it over one hip. From this time on the pulsations of the cord should be carefully watched, and, in case of failing strength, extraction should be resorted to.

With one hand the physician now supports the body of the child,

* Dubois, Mém. de l'Acad. Roy de Méd., vol. iii, p. 450.

while with the other he should make sustained and gradually increasing pressure upon the fundus uteri. The patient should be exhorted to strain, and bring into play all the auxiliary muscles concerned in expulsion. During the passage of the arms, the lateral flexion of the body should be promoted by raising the hips and supporting the perinæum. After the engagement of the head, it is desirable, if possible, to commit to the hands of a skilled assistant the maintenance of the supra-pubic pressure. When the face reaches the coccyx, the physician should raise the body of the child toward the abdomen of the mother. By this manœuvre the occiput is pushed upward by the pubic wall, and the chin brought forward to the vulva. The delivery of the head is then speedily accomplished by pressing the forehead forward with two fingers applied to the perinæum in front of the coccyx, or introduced into the rectum. By then keeping the head flexed, lacerations of the perinæum are best avoided.

When the occiput is turned posteriorly, the body should be raised if the chin is arrested at the symphysis, and depressed when flexion is complete.

CHAPTER XI.

CONDUCT OF NORMAL LABOR.

Preliminary preparations.—Examination of the patient.—Management of the first stage.—Management of the second stage.—Preservation of the perinæum.—Delivery of the shoulders.—Tying the cord.—Third or placental stage.—Care of patient after delivery.—Treatment of perineal lacerations.—Anæsthetics in midwifery.

It is hardly an exaggeration to state that the greater proportion of the sins of midwifery practice are committed in the management of normal labors. It is equally easy to fall into errors of commission and errors of omission. It is as necessary to know when to abstain as when to interfere. It is an old but always good rule, not to meddle with the physiological performance of a function; but the rule, when applied to obstetrics, presupposes a thorough familiarity with the physiological processes of childbirth, and the contingencies to which women in parturition are exposed. There is no sense in reposing a blind, unreasoning confidence in the powers of Nature. Indeed, legitimate grounds for interference are liable to arise in the simplest labors. The attitude of the medical attendant should be one of watchful expectancy. He should be ready, if needful, to assuage pain, to forestall dangers, and to limit the duration of suffering.

Preliminary Preparations.—When summoned to a patient, the physician should go armed to meet the sudden emergencies of obstetrical

practice. His armamentarium should include a silver catheter, an English catheter of small size (No. 7) for use in asphyxia of the newborn child, a pair of forceps, needles and needle-holder, and silk or wire for sutures, a Davidson syringe, a set of Barnes's dilators, and a hypodermic syringe. He should go provided with chloroform, Magendie's solution of morphia, ergot, the perchloride or persulphate of iron, carbolic acid, powders or tablets of corrosive sublimate, and a small vial of sulphuric ether. At the house, ice, brandy or whisky, hot and cold water, a new English gum catheter (No. 10), and a fountain syringe, should be had in readiness.

As it is not uncommon for women, especially among the poorer classes, to test the experience of young physicians by asking details relative to the arrangement of the bed upon which the confinement is to take place, it is trusted that a few words upon the subject will not be regarded as entirely superfluous.

The bedstead should not be too low. If against the wall, it should be moved out, so as to allow easy access from both sides. The bedding should consist of a hair mattress or of a straw paillasse. Feather-beds are an abomination. Over that portion of the mattress upon which the woman expects to lie, a rubber-cloth or other impervious material should be spread. Next to the water-proof, nurses usually lay a folded woolen comforter or blanket, to absorb the fluid discharges. The whole is then covered smoothly with a sheet, and a second sheet, folded in several thicknesses, is laid beneath the hips of the patient. All these preparations are designed to limit the soiling of the bedding to a circumscribed space, and to facilitate the removal of the discharges after the termination of the delivery. The sheets and articles in contact with the patient should be freshly washed. Soiled linen is incompatible with the requirements of aseptic labor.

Examination of the Patient.—The first duty which devolves upon the physician in the lying-in chamber is to examine his patient, and to inform the family if "all is right"—i. e., whether the head presents, and no unusual obstacle to delivery exists. It is a good plan at the outset to map out the fœtus through the abdominal and uterine walls, as by palpation alone it is usually possible to determine the dorsum of the child, the presentation at the pelvic brim, the direction of the feet, and the presence or absence of fetal movements. So, too, by external methods we are enabled to make out the size and shape of the uterus, the existence of hydramnion, the presence of twins, or of complicating tumors. The strength and frequency of the fetal heart-sounds should be ascertained by auscultation. Inspection and palpation of the pelvis suffice to make evident grosser varieties of deformity. Nearly everything in the way of essential information is obtainable without resorting to an internal examination—a fact of no mean im-

portance when a physician finds himself obliged to conduct a case of labor when fresh from contact with materials capable of conveying infection.

Before proceeding to a vaginal examination the physician should scrupulously clean the nails, the hands, and forearms with soap and water, then wash them with pure water, and afterward immerse them for several minutes in a solution of corrosive sublimate in the proportion of one to a thousand. Similar precautions should be taken by the nurse; and in the same way the external parts, the perinæum, the mons veneris, the inner surface of the thighs, and the abdomen of the patient, should be freed from impurities. Soap and water should be preferred as a lubricant for the fingers. Under normal conditions the vagina is to be regarded as aseptic. Douching, therefore, with strong solutions of carbolic acid or corrosive sublimate is not indicated as a prophylactic measure.

The internal examination should take cognizance of the condition of the vulva and perinæum, the state of the rectum and bladder, the length of the vagina, the degree of dilatation and softening of the cervix, the amount of cervical and vaginal secretion, the hardness of the child's head, the dimensions of the pelvis, and, if the membranes are not ruptured, the quantity of amniotic fluid. It is customary to begin the examination during an interval between the pains, but it is often convenient to continue the investigation during the pains, in order to judge of their efficacy and character.

The history of the case should embrace the length of previous labors, the health during pregnancy, the number of times the woman has been pregnant, and whether in the present instance she has advanced to full time. Inquiries should be made as to when the labor-pains commenced, as to their frequency and situation, and if the membranes have ruptured.

After the examination of the patient is ended, the physician is expected to express an opinion as to the probable duration of the labor. It is, however, necessary for the responses upon this point to be guarded and Delphic. In general terms, when the pelvis is normal, the head well flexed, the vagina short, and the cervix and perinæum are dilatable, an easy and rapid labor is to be anticipated; while, *per contra*, with a small pelvis, tardy flexion, a long vagina, and rigidity of the uterine and perineal orifices, a tedious period of waiting is to be assumed. Of course, too, labor is, as a rule, much longer in primiparæ than in women who have previously borne children. Moreover, with few exceptions, the result depends in a special degree upon the energy and persistence of the pains. The latter, however, represent always the uncertain element in the calculation. If the pains are good, therefore, the reservation should be made that, for a short labor, they must continue as at the beginning; while, if weak and powerless,

it should be stated that better pains will be needed to bring the labor to a speedy conclusion.

Management of the First Stage of Labor.

The duties of the physician during the first stage of labor are, in normal cases, extremely simple. He should from time to time, say at hourly intervals, repeat the examination with the precautions already indicated, with a view to inform himself of the progress of dilatation. He should caution his patient to pass her urine frequently. In case of retention, he should draw the water with a catheter. When the head is low down, the urethra often follows its convexity. The introduction of the straight female catheter may then be extremely difficult. Many recommend in such cases a silver male catheter to which a suitable curve has been given. I use by preference the English flexible catheter, which is passed easily, provided the end is guided by the index-finger, through the anterior vaginal wall, to the point of contact between the head and the symphysis pubis. A flattening of the tube by pressure to an extent causing obliteration is not likely to take place. The catheter should be a new one, of about the No. 10 size.

In many instances certain hindrances to labor are remediable by postural methods. Thus, in the half-sitting posture, with the shoulders raised, the axis of the uterus assumes a direction vertical to the pelvic brim. This attitude contributes to bring the weight of the ovum to bear directly upon the lower segment, and tends to correct presentations of the posterior parietal bone. The direction of the head to the sacrum in pendulous abdomen is to be remedied by the complete dorsal decubitus. Marked lateral deviations of the cervix are to be corrected by placing the patient upon the opposite side.

If at the time of examination the rectum is found clogged with fæces, an enema should be ordered. A disposition on the part of the patient to bear down during the first stage of labor should be discouraged, as wasting her strength without possessing any counterbalancing utility. The patient should be encouraged not to take to bed at the outset of labor. In the upright or sitting posture gravity aids the fixation of the head and promotes passive hyperæmia and dilatation of the cervix.

As the end of the first stage approaches, however, the woman should undress and lie down, as the pains after rupture usually follow one another with rapidity, and make locomotion difficult. To avoid soiling, the night-dress should be drawn well up under the arms. Tidy nurses pin a folded sheet around the hips of their patients, to arrest the soaking of fluids upward.

Rupture of the membranes is ordinarily a spontaneous act. Yet often enough something may be done in the way of shortening labor by puncturing the membranes so soon as cervical dilatation is complete.

They have then fulfilled their physiological mission, and their persistence simply retards the advance of the child's head. Artificial rupture is easily effected by means of a straightened hairpin passed in the groove between the index and middle fingers of the examining hand to the amniotic pouch. The puncture should be made during a pain, at a time when the membranes are tense and separated from the scalp by a deep layer of fluid.

Management of the Second Stage of Labor.

The management of the second stage of labor calls for considerable tact on the part of the medical attendant. It is incumbent upon him to make examinations from time to time to determine the degree of rapidity with which the descent of the head takes place. So long as the advance is regular, he should abstain from interference. Should the pains slacken, however, he should not allow the duration of the second stage to exceed the physiological limits. It is not easy to define exactly what is implied in the expression, "physiological limits." As a rule, a very rapid second stage is not physiological, as it endangers the integrity of the vagina and perinæum, and predisposes to *post-partum* hæmorrhage. Still, now and then labor is ended by a single pain after rupture of the membranes, without detriment to the mother. Of course, such cases are extremely uncommon in primiparæ. They require an unusually distensible condition of the soft parts and an extraordinary degree of resiliency in the uterus. On the other hand, pressure of the head, after its descent into the pelvic cavity, leads, if too long continued, to pathological changes in the tissues of the canal and of the outlet. It is usual, therefore, unless the head is small or the pelvis roomy, to use the resources of art to terminate labor when the head remains stationary at the perineal floor after two hours of effort. It is desirable, therefore, when the pains are weak and ineffective, to utilize all the simple adjuvants which experience has shown to possess real efficacy in increasing the activity of labor.

Changes of posture increase the power of the pains temporarily. When head-flexion is incomplete, it has been recommended to place the patient upon the side toward which the occiput is turned. Others, again, claim that the descent of the occiput is best effected by placing the mother upon the side toward which the child's forehead is directed. In point of fact, either posture frequently leads to the desired result, simply because the change from the dorsal to the lateral position is apt to be followed by a temporary addition to the uterine force.*

In many women, owing to defective innervation or to insufficient development of the muscular structures of the uterus, it is of great moment that the expulsion of the child be aided by the voluntary

* Laus, Die Theorie der Geburt, Bonn, 1877, p. 237.

pressure of the abdominal walls. To be sure, in most cases the reflex impulse to bear down is imperative; but in others, where the impulse is feeble or held in abeyance by the dread of the patient lest she increase her sufferings, it becomes the duty of the physician, in tardy labors, to see to it that all the auxiliary forces are brought into play. To this end he should instruct his patient to fix her pelvis, either by pressing her feet against the foot board of the bed, or by drawing up her knees and resting them against an assistant, who assumes the position best adapted to furnish the requisite support. Then the nurse, or other suitable person, should grasp the woman's hands, so as to enable her to fix her thorax and to bring all the expiratory muscles into full exercise. Often, when the agony is intense the patient can be induced to strain with her pains, if her sufferings are first dulled by small doses of chloroform. When the head is on the perinæum, the physician may further expulsion by rubbing the abdomen to excite pains, and by pressing upon the breech through the fundus.

During the second stage the patient's posture should be left in general to her own volition. The physician should accustom himself to conduct labor with equal facility, no matter whether the woman lies upon her side or upon her back. The left lateral position, affected by English accoucheurs, is very convenient at the time of delivery, especially when there is occasion to support the perinæum, and where, owing to the flatness of the nates, the vulva is scarcely raised in the dorsal posture above the level of the bedding.

The Preservation of the Perinæum.

By far the most delicate task which the physician has to fulfill toward his patient in the expulsion stage consists in so regulating the exit of the child's head as best to avoid perineal lacerations. It is needless to state that such lacerations, unless of slight extent, entail upon women a variable degree of subsequent discomfort and suffering. When the perinæum is examined with care after labor—a practice which should be invariable with a conscientious attendant—the frequent occurrence of more or less extensive rupture of its tissues is a matter of easy confirmation. Statistics of their frequency are of little value, much depending upon individual skill in management. Olshausen* reports, as the result of the preventive measures adopted at the clinic in Halle, during a period of ten years, 21·1 per cent of perineal injuries in primiparæ and 4·7 per cent in multiparæ. These percentages did not include slight tears confined to the frænulum. He regards 15 per cent as not too high an estimate for the absolutely unavoidable

* Olshausen, Ueber Dammverletzung und Dammschutz, Volkmann's Samml. klin. Vortr., No. 41, p. 360.

lacerations, due to defective distensibility of the perinæum, and to the disproportionate size of the child's head.

The aim of prophylactic measures should be to develop the elasticity of the soft parts to the fullest practicable extent, and to cause the head to pass through the distended orifice of the vulva by its smallest diameters. Preliminary softening of the perinæum is best accomplished by the continuous but not too rapid descent of the presenting part. The relaxation, as a rule, begins earlier and is more complete in multiparæ than in primiparæ. In a few cases the soft parts will already have ceased, by the end of the first stage of labor, to offer any effective barrier to delivery. The distensibility of the soft parts may be fairly inferred from the presence of a copious discharge of glairy mucus.

When rupture takes place, the vaginal mucous membrane is the first structure to give way. In the ordinary form the perineal body tears from the commissure backward to the rectum. In rare cases a central perforation may result, and the child be expelled through a rent situated between the vulva and the anus.

When the head begins to make the perinæum bulge the physician should be on the alert, and inform himself during each contraction of the strain to which the parts are subjected. At first it is only necessary to rest the hand lightly upon the perinæum. Direct pressure is to be avoided, except when the perinæum is stretched to a membranous thinness, and the danger of central perforation threatens. As the head begins to distend the vulva, the tension at the frænulum should be carefully gauged by a finger introduced between the labia. Measures to avert rupture may be classified under three headings, viz.:

1. Those designed to check the exit of the head before the fullest expansion has been secured, and to prevent expulsion during the acme of a pain, when the borders of the orifice are most rigid.

2. Measures which impart an upward movement to the head, with a view of making all unoccupied space beneath the arch of the pubes available.

3. Measures which favor expulsion during the interval between the pains, or at least after the acme has subsided.

In ordinary cases Hohl's method, recommended by Olshausen,* has rendered me excellent service. It consists in applying the support not to the perinæum but to the presenting part. To this end the thumb should be applied anteriorly to the occiput, and the index and middle fingers posteriorly upon that portion of the head which lies nearest to the commissure. The unconstrained position of the hand enables the operator to exercise effective pressure in the direction of the vagina, while the posterior fingers favor the rotation of the head under the pubic arch. The patient should at the same time be directed

* Olshausen, *loc. cit.*, p. 366.

not to hold her breath during the pains, except when they are weak and powerless. Where the impulse to bear down is irresistible, chloroform should be given to annul the excessive reflex irritability. Under the most skillful management laceration is liable to occur, unless the physician is able to control the action of the auxiliary expulsive forces.

So soon as the bi-parietal diameter passes the tense border of the vulva the perinæum retracts rapidly over the face, and the expulsion of the head is completed. It is during this period that laceration is most apt to occur. This danger is, however, greatly lessened if the head is made to issue through the orifice after the pain has subsided, and when the soft parts are in a relaxed and dilatable condition. To accomplish this, in many instances where the resistance to be overcome is slight, it is sufficient for the woman to hold her breath during an interval between the pains, and voluntarily call into play all the muscles of expiration. In the larger proportion of cases, however, these efforts are futile, because of the comparatively feeble motor force brought into action.

An excellent method of manual delivery we owe to Ritgen,* which consists in lifting the head upward and forward through the vulva, between the pains, by pressure made with the tips of the fingers upon the perinæum behind the anus close to the extremity of the coccyx. Of course, the method is only available after the head has descended sufficiently for the pressure to be exerted upon the frontal region.

Rectal expression has lately found warm advocates in Olshausen † and Ahlfeld.‡ The manœuvre consists in passing two fingers into the rectum toward the close of the second stage of labor, and hooking them into the mouth or under the chin of the child through the thin recto-vaginal septum. By pressing the face forward and upward, the normal rotation of the head beneath the pubic arch can be effected, and delivery can be accomplished between the pains at the will of the operator.

When rupture is felt to be imminent, mock-modesty should be discarded, and the parts imperiled should be unhesitatingly exposed to view. If, owing to its excessive elasticity, the occiput, in place of being directed forward to the vulva by the perinæum, distends the latter so that central perforation threatens, the hand should be applied in such a way as to give direct support to the stretched tissues and to guide the head upward to the outlet. If, on the other hand, the danger arises from defective elasticity, the physician, standing to the right of the patient, with his face toward the foot of the bed, should

* Olshausen, Ueber Dammverletzung und Dammschutz, Volkmann's Sammlung., No. 41, p. 369.

† See Ahlfeld, Das Dammschutz Verfahren nach Ritgen, Arch. f. Gynaek., vi, p. 279.

‡ *Loc. cit.*

pass the left hand between her thighs and press the head upward and inward, during each pain, with the thumb and two fingers, as previously described. At the same time, the movement of extension, should it threaten danger to the parts, should be hindered by pressing backward upon the frontal region, through the perinæum, with the disengaged hand.

Dr. Goodell* recommends hooking two fingers into the anus and drawing the perinæum forward during a pain, to remove the strain from the thinned border of the vulva, and to promote the elasticity of the tissues.

Merkerttschiantz advocates the employment of bilateral pressure upon the perinæum during the pains to diminish the tension in the median line where rupture usually occurs. To accomplish this the patient lies upon her back with her knees moderately separated. The physician sits to the right of the patient. The right hand is then placed beneath the right thigh, with the thumb and the fingers respectively applied to points on the right and left of the perinæum. The points selected should correspond as nearly as possible to the region where the strain is the greatest. During a pain the thumb and fingers should be employed to press the perineal tissues from the sides toward the center. When the presenting part begins to distend the vulva, the left hand should be placed with the ulnar border over the mons veneris, and with the thumb and fingers respectively applied to the right and left labia. As the frænulum is put upon the stretch, the middle finger and the thumb should guard by lateral pressure a point in the perinæum about half an inch from the anterior border. This point should likewise be sustained at the same time from below by the thumb and fingers of the right hand. Merkerttschiantz† reports over 110 cases treated by this method without a single perineal laceration. More recently a plan which is the same in principle has been recommended by Dr. T. J. McGillicuddy, of this city.‡

Fasbender§ places the patient upon the left side; then, standing behind her, he seizes the head between the index and middle fingers of the right hand, applied to the occiput, and the thumb thrust as far into the rectum as possible. By this manœuvre the head is held under complete control, the rectal wall hardly affecting the grip in any appreciable manner. During a pain the progression and extension of the head are readily prevented. During the interval between the pains, by pressure with the thumb through the rectum and the posterior portion of the perinæum, the head can be pressed forward and outward at the will of the operator.

Between pains, I have been in the habit, in cases of rigidity, of alternately drawing the chin downward through the rectum until the head distends the perinæum, and then allowing it to recede. It is as-

* Goodell, Am. Jour. of the Med. Sci., January, 1871.

† Merkerttschiantz, Arch. f. Gynæk., vol. xxvi, p. 327, 1885.

‡ *Vide* Am. Jour. Obst., Dec., 1889, p. 1241.

§ Fasbender, Ztschr. f. Geburtsh. und Gynæk., Bd. ii, H. 1, p. 58.

tonishing how often apparently the most obstinate resistance can be overcome by the simple repetition of this to-and-fro movement, the parts rapidly becoming soft and distensible. Of course it should be discontinued the moment contraction begins, and care should be taken to effect delivery after uterine action has subsided.

With judicious management the number of unavoidable lacerations can be restricted to a small proportion of cases. Still, there are individual peculiarities which will now and then render abortive the best prophylactic measures. In this category I have already alluded to a primitive lack of development of the maternal parts, to unusual size of the child's head, and to the excessive rigidity of the perinæum in primiparæ, especially after the thirtieth year. In addition, should be mentioned cases where the pubic arch is diminished by the approximation of the pubic rami, or where the tissues have been rendered friable from chronic œdema, from a varicose condition of the veins, from condylomata, from syphilitic sores, or from inflammatory infiltration consequent upon undue prolongation of the second stage of labor. Lacerations are more frequent in occipito-posterior positions, and in the delivery of the after-coming head, where hasty extraction is demanded in the interest of the child.

When, in the judgment of the physician, rupture of the perinæum seems inevitable, he is justified in making lateral incisions through the vulva to relieve the strain upon the recto-vaginal septum. To this operation the term episiotomy is applied. By it not only is the danger of deep laceration through the sphincter ani prevented, but, owing to their eligible position, the wounds themselves are capable of closing spontaneously; whereas, when laceration follows the raphé, the retraction of the transversi perinæi muscles causes a gaping to take place which interferes with immediate union. As, however, every wounded surface is a source of danger in childbed, episiotomy should never be performed so long as hope exists of otherwise preserving the perinæum. It is essentially the operation of young practitioners, the occasions for its employment diminishing in frequency with increasing experience. The chief resistance encountered by the head is not at the thin border of the vulva, but is furnished by a narrow ring situated half an inch above, and composed of the constrictor cunni, the transversi perinæi, and sometimes of the levator ani muscles. Incisions should be made during a pain, when the ring becomes tense and rigid, and is easily recognized with the finger. As it is not desirable that the head should be driven suddenly through the vulva during the act of operating, the time selected for performing episiotomy should be at the commencement or close of a contraction. The division of the rigid fibers may be accomplished by means of a blunt-pointed bistoury, or a pair of angular scissors. So far as practicable, the incisions should be confined to the vagina, and should not exceed three quarters of an inch

in length. In cases where the head is on the eve of expulsion, the bistoury may be introduced flat between it and the vagina, half an inch anterior to the commissure, and the section made from within outward. Care, however, should be taken at the same time to avoid severing the external skin by drawing it as far back as possible.* In central perforation it is best to divide the band left attached to the vulva, as its preservation is of no advantage.

The Delivery of the Shoulders.—After the expulsion of the head, mucus should be wiped from the mouth and nose, and cleared from the throat with the finger should laryngeal *râles* indicate an embarrassment of the respiration. If the cord is found coiled around the neck, it should be loosened by drawing upon the placental end until the shoulders can pass readily through the loop. Should this be found impossible, either because the cord is unusually short, or because it is wound several times around the body, a ligature should be applied, the cord should be cut between the ligature and the placenta, and delivery should be hastened by manual efforts.†

In the majority of cases the shoulders are expelled spontaneously. Still, it is a good plan to expedite the descent by pressure made with the left hand at the fundus of the uterus. Care must be taken lest the lower shoulder convert a slight tear in the perinæum into an extensive laceration. The right hand should therefore be applied to the perinæum in such a way as to lift the shoulder upward, and at the same time furnish a bridge over which it can glide in its movement forward. Sometimes after the passage of the head a deep vaginal laceration coexists with an intact condition of the external parts. The shoulder then tears through the skin, and a complete rupture ensues. Olshausen recommends, in cases where rupture is imminent, to turn the shoulders so that they clear the vulva in an oblique or transverse diameter.

If, after birth of the head, the child does not breath, and asphyxia threatens, the physician should rub the uterus with the hand through the abdominal wall, to excite a pain, during which he should urge the patient to press down, and thus aid expulsion. The most common hindrance to delivery consists in an arrest of the upper shoulder beneath the pubes. Usually its release is readily effected by seizing the sides of the head with the two hands and drawing directly downward. It is rarely necessary to raise the head subsequently, or to hook the finger into the armpit to extract the posterior shoulder.

Tying the Cord.—When the cord is torn across, as sometimes happens in street-births, no hæmorrhage takes place from the lacerated

* Olshausen, *loc. cit.*, pp. 372, 373.

† Tarnier recommends dividing the cord and then compressing the proximal end between the thumb and the index-finger. The proximal end is distinguished by the spouting of the two umbilical arteries.

vessels. Of course, this occurrence deprives the physician of the power of choosing the point at which the division shall be made. As it is desirable, for the sake of convenience, to sever the cord about two inches from the navel, it is the custom in all civilized countries to cut it with scissors, and to prevent hæmorrhage by the application of a ligature. Almost any material may be employed for the latter purpose, though nothing is so handy as the narrow flat bobbin which most nurses keep in readiness. Dr. Craig, of Jersey City, recommends the use of an elastic ligature as a security against hæmorrhage. The ligature should be applied tightly, and the cut surface should subsequently be examined once or twice by the physician before leaving, to make sure that the arteries are sufficiently compressed to prevent oozing from taking place. The cord should be held in the hollow of the hand at the time of its division, to avoid the possibility of including accidentally any portion of the child between the blades of the scissors. Commonly two ligatures are applied, and the cord is severed between them, though the question of one or two ligatures is, except in twin pregnancies, of trifling importance.

In practice it is very desirable that the physician should understand the physiological difference between the effects of the early and those of the late application of the ligature. The custom as regards this point has been by no means uniform. The ancients deferred the ligature until after the expulsion of the placenta. Mauriceau, Clément, and Deventer followed the same plan, but employed artificial expedients to complete the third stage of labor rapidly.* The common practice at the present day is to tie the cord immediately after the birth of the child. Still, there have not been wanting in recent times warning voices against precipitate action. Naegele advised waiting until the pulsation of the cord had ceased; Braun† first describes the changes from the fetal to the post-natal circulation, and then says: "This stupendous process should be taken into consideration in the treatment of every case of labor, and because of it the cord should never be severed or tied so long as pronounced pulsations can be felt near the navel." Stoltz‡ noticed that "after the child has respired

* Budin, À quel moment doit-on opérer la ligature du cordon ombilical? Publications du Progrès Médical, 1876.

† Braun, Lehrbuch der Geburtshülfe, p. 192.

‡ Stoltz, art. Accouchement naturel, Nouveau Dictionnaire, p. 283. So, too, White wrote, in 1773: "The common method of tying and cutting the navel-string the instant the child is born is likewise one of those errors in practice that has nothing to plead in its favor but custom. Can it be supposed that this important event, this great change which takes place in the lungs, the heart, and the liver, from the state of a fœtus kept alive by the umbilical cord to that state when life can not be carried on without respiration, whereby the lungs must be fully expanded with air, and the whole mass of blood, instead of one fourth part, be circulated through them, the ductus venosus, foramen ovale, ductus arteriosus, and the

well division of the cord is followed by an insignificant loss of blood, while after immediate section blood escapes in abundance." Winkler,* from anatomical observation alone, recommended not to tie the cord until the expulsion of the placenta, or at least until the cord had become pale and had ceased to pulsate, giving as his reason that by delay a certain quantity of blood would pass from the placenta to the child, and that every plus is a gain to the child, which would increase its powers of resistance. He finally expressed it as almost his belief that the practice recommended would tend to diminish the familiar loss of weight in the new-born during the first days of existence.

In 1875, Budin, at that time interne at the Maternité of Paris, undertook the following experiments at the suggestion of Professor Tarnier: In one series, the cord was tied immediately after the birth of the child, and the blood which escaped from the placental extremity was measured; in the other, the quantity of blood was determined in cases where the cord was not tied until several minutes after delivery. By a comparison of the results thus obtained, he found that the average amount of placental blood was three ounces greater in the first than in the second series of experiments.† Welcker estimated the entire quantity of the blood in the infant at one nineteenth the weight of the body, which would amount, in a child of seven pounds, to six ounces. To tie the cord immediately after birth would therefore be equivalent to robbing the child of three ounces of blood which would otherwise pass into its circulation. This startling result has in the main been abundantly confirmed by subsequent observers. Two years later (1877), Schücking, extending Budin's experiments by weighing the child at birth and then observing the changes that took place up to the time of the cessation of the placental circulation, found that the child gained from one to three ounces in weight by delay. It is certain that these amounts do not represent the entire increase, as a portion necessarily escapes observation in the interval that must elapse before the weight can be ascertained.

There is a difference of opinion as to the mechanism by which the

umbilical arteries and veins must all be closed, and the mode of circulation in the principal vessels entirely altered—is it possible that this wonderful alteration in the human machine should be properly brought about in one instant of time, and at the will of a bystander? Let us but leave the affair to Nature and watch her operations, and it will soon appear that she stands not in need of our feeble assistance, but will do the work herself at a proper time and in a better manner. In a few minutes the lungs will be gradually expanded, and the great alterations in the heart and blood-vessels will take place. As soon as this is perfectly done the circulation in the navel-string will cease of itself, and then if it be cut no hæmorrhage will ensue from either end. . . ." A Treatise on the Management of Pregnant and Lying-in Women, by Charles White, London, 1773, p. 107.

* Winkler, Arch. f. Gynaek., vol. iv. p. 256 (1872).

† Budin, *loc. cit.*

transfer of the blood from the placenta to the child takes place. According to Budin, the principal factor in the accomplishment of the result is thoracic aspiration. With the first breath, the afflux of blood to the lungs develops a "negative pressure" in the vessels of the larger circulation, so that a suction force is exerted upon the placental blood, which continues until the equilibrium is restored. To tie the cord prematurely, therefore, is to cut off from the child a supply of blood for which the establishment of the pulmonary circulation had created a physiological need.

Schücking,* on the contrary, maintains that, after the first inspiration, thoracic expansion ceases to operate as an active force, and that the main agent which drives the blood from the placenta through the umbilical vein is the compression exerted by the retraction, and, at intervals, by the contractions of the uterus.

The difference in the theoretical standpoint of these two observers is of practical importance, for, if the movement of blood to the child results from thoracic aspiration, the quantity which enters its circulation will not exceed its requirements; while, if the movement is due to uterine compression, the question arises as to whether the forcible transfusion thus accomplished is compatible with the child's safety and welfare. The ultimate decision will depend partly upon experimental and partly upon clinical observations. Provisionally, the case stands as follows: The manometric observations of Ribémont † show that the pressure in the umbilical arteries is uniformly greater than that in the umbilical vein; during a series of deep inspirations and expirations the blood in the umbilical vein is subject to marked oscillations; after the pulsations of the cord have ceased, the uterine contractions alone are insufficient to propel the placental blood through the umbilical vein to the infant. Again, Budin (discussion upon Ribémont's paper), in a breech-delivery, compressed the cord at the vulva as far as possible from the navel; at birth, the vein was distended with blood, but with the first inspiration it was instantly emptied. Thoracic aspiration does, therefore, exist as an operative force. On the other hand, Schücking found that when the placenta was rapidly expelled by Credé's method, so as to remove it from the influence of uterine retraction, the pressure in the vein was slightly lessened, and the total amount of blood transferred to the infant was greatly restricted.

According to the clinical observations of Budin, Ribémont, and Schücking, infants which have had the benefit of late ligation of the cord are red, vigorous, and active, whereas those in which the cord

* Schücking, Zur Physiologie der Nachgeburtsperiode, Berl. klin. Woch., Nos. 1 and 2, 1877.

† Ribémont, Recherches sur la tension du sang dans les vaisseaux du fœtus et du nouveau-né, Arch, de Tocol., October, 1879.

is tied early are apt to be pale and apathetic. Hofmeier,* Ribémont, Budin, and Zweifel † have shown that the loss of weight which occurs in the first few days following confinement is less in amount and of shorter duration when the cord is not tied until after the pulsations have ceased.

There appear to be no harmful results to the child growing out of the practice of late ligation. Porak, indeed, reports two cases of dark vomiting, two of melæna, and two with sanguineous discharges from the vagina, which he is convinced were the result of the practice; but the extensive trial to which it has since been subjected in the principal lying-in institutions of the Continent have sufficiently demonstrated that it is exempt from danger.

In late ligation, the amount of blood retained in the placenta and the increase in the weight of the child differ materially in different cases ‡—a difference which seems to indicate that, so long as the placental circulation is left undisturbed, the amount of blood passing to the child will be measured by its needs. In a case of Illing's,# on the other hand, after the placenta had been expressed from the uterus, its contents and that of the cord were forcibly squeezed into the circulation of the child, and death followed from overdistention of the heart. Porak and Georg Violet ‖ claim that there is a special predisposition to icterus in children when the cord is tied after the placental circulation has ceased. Violet attributes the discoloration not to bile-pigment but to a rapid disintegration of the excess of blood-corpuscles. Helot, he says, found on the first day after the birth a difference of nine hundred thousand corpuscles to the cubic millimetre between cases of late and those of early ligation, while on the ninth day the difference fell to three hundred thousand. Others have failed to notice any characteristic icteric discoloration peculiar to late ligation. Neither Porak nor Violet attaches any pathological significance to the symptom.

The outcome of the foregoing observations may fairly be stated as follows:

1. The cord should not be tied until the child has breathed vigorously a few times. When there is no occasion for haste arising out of the condition of the mother, it is safer to wait until the pulsations of the cord have ceased altogether.

* Der Zeitpunkt der Abnabelung, etc., Ztschr. f. Geburtsh. u. Gynaek., iv, 1, p. 114.

† Zweifel, Centralbl. f. Gynaek., No. 1.

‡ See Wiener, Ueber den Einfluss der Abnabelungszeit auf den Blutgehalt der Placenta, Arch. f. Gynaek., xiv, 1, p. 34; also, Meyer, Centralbl. f. Gynaek., 1878, No. 10.

Inaug. Diss., Kiel, 1877.

‖ Georg Violet, Ueber die Gelbsucht der Neugeborenen und die Zeit der Abnabelung, Virchow's Archiv, lxxx, 2, p. 353.

2. Late ligation is not dangerous to the child. From the excess of blood contained in the fetal portion of the placenta, the child receives into its system only the amount requisite to supply the needs created by the opening up of the pulmonary circulation.

3. Until further observations have been made, the practice of employing uterine expression previous to tying the cord is questionable.

4. In children born pale and anæmic, suffering at birth from syncope, late ligation furnishes an invaluable means of restoring the equilibrium of the fetal circulation.

Management of the Third or Placental Stage of Labor.

The duties of the physician in the third stage are to guard against hæmorrhage, to promote uterine contractions, and to further the expulsion of the placenta. These objects are best fulfilled by manipulations through the abdominal walls. Tractions upon the cord should not be resorted to before the placenta has accomplished its descent into the vagina. The method of expressing the placenta by seizing the uterus through the abdominal coverings is associated indissolubly with the name of Credé, for, though the value of friction, of kneading, and compression, was appreciated, as their writings show, by Mauriceau, Robert Wallace Johnson, Joseph Clarke, Busch, Mayer, and others,* it was Credé who, by independent study, worked out the practical details of the manœuvre, and by his advocacy gained for the principle of placental expression its present wide-spread acceptance.

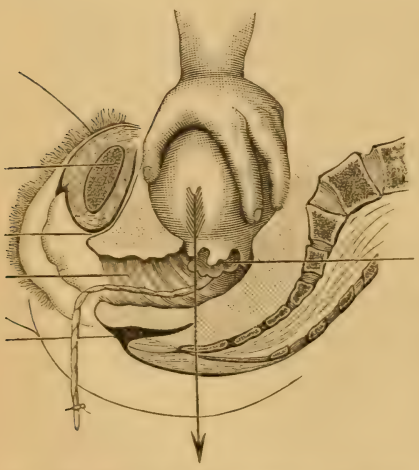


Fig. 122.—Expression of the placenta. (Credé.)

Credé's method consists essentially in applying at first light and afterward stronger friction to the fundus of the uterus until an energetic contraction is obtained; at its height the uterus is grasped so that the fundus rests in the palm of the hand, compressed between the thumb and fingers. The exercise of circular compression forces the placenta from the uterus, or in case of failure the process may be repeated until the object is accomplished. Credé lays great stress

* For historical references, *vide* Riol, Délivrance par expression, G. Masson, 1880; Mundé, Obstetric Palpation, p. 103.

upon the avoidance of violence in the practice of his method. It is true that the expulsion of the placenta will, as a rule, occur spontaneously. The unaided uterus is, however, liable to relax and become the source of hæmorrhage; or, where the delivery does not take place speedily, it may, on the other hand, close down so as to imprison the placenta within its cavity. The great merit of Credé's method is that by maintaining retraction it prevents hæmorrhage, and by promoting speedy expulsion it guards against the dangers of retention. When systematically practiced, the bugbear known as adherent placenta is the rarest of accidents. The method is not difficult, and is devoid of danger. To be successful, however, expression should be employed only during the acme of a contraction, and the propulsive force should be directed from the fundus downward in the axis of the uterus.

Credé in his earlier papers advocated the expression of the placenta as soon after the birth of the child as possible. It appears, however, from the observations of Schroeder and others, that in most cases the placenta spontaneously leaves the uterine cavity, either in whole or in part, within the first fifteen to twenty minutes after the birth of the child, and that the delay observable in so many cases left to the unaided efforts of Nature occurs usually after the placenta has sunk into the lower uterine segment. For this reason it is a good rule, accepted of late by Credé, not to resort to external manipulations until at least fifteen minutes have expired.

The evidence of the expulsion of the placenta is furnished to the operator by his feeling the anterior and posterior walls in contact with one another. By then pressing the uterus downward in the axis of the brim it is usually possible to drive the placenta through the vagina and out of the valva. There is no objection, however, at this stage, in case of delay, to expedite delivery by drawing upon the cord downward and backward. When the placenta passes the vulva the uterus is often firmly contracted, and a considerable portion of the membranes are still within the uterine cavity. Hasty traction is then apt to tear off the retained part of the membranes. It is well, therefore, at this point to support the placenta until relaxation of the uterus has taken place, when the complete separation of the membranes is effected without endangering their integrity.

There has been considerable discussion of late as to the true physiology of placental expulsion. Thus it has been maintained by Schultze that after the birth of the child the diminution of the placental area during a uterine contraction is followed by a central separation of the placenta from the uterine walls and by a bulging of the separated portion into the uterine cavity. The detachment takes place in the decidual layer; the mouths of uterine vessels are consequently opened up, and blood is aspirated into the retro-placental cavity. As, in point

of fact, no uterine cavity exists during a contraction, Cohn * modified the Schultze theory by assuming that the central separation takes place in fact as a consequence of uterine contraction, but that the hematoma follows upon the occurrence of uterine relaxation. The further separation of the placenta from the center toward the periphery is either the result of the increase in the amount of the effused blood, or is effected during a contraction by the peripheral pressure exerted by the blood previously aspirated behind the placenta. According to Schultze, therefore, the placenta normally descends by its fetal surface into the vagina, and a certain amount of hæmorrhage is the regular concomitant of placental expulsion.

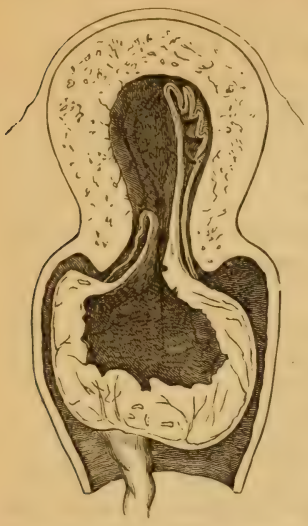


FIG. 123.—Descent of the placenta according to Schultze.

Dohrn,† accepting the views of Schultze, objects to Credé, that by his method "a process which should develop naturally is disturbed by a comparatively brusque manipulation." As a result of hasty placental expression, he mentioned as especially to be deprecated the tendency to retention of the membranes. Later, Ahlfeld ‡ urged against the Credé method that it increased the cases of dangerous hæmorrhage, that it favored retention of the membranes, and that, as a consequence of the latter accident, it created a disposition to puerperal fever. The evils depicted by Dohrn, and especially by Ahlfeld, of the results of manual expression of the placenta, were so entirely opposed to my own experience, that during the past ten years I have continued to follow, with slight modifications, the counsels of Credé, and remain unconvinced that they do not furnish the best practical solution of the safe management of the stage of labor. When skillfully performed, I know of no other obstetrical manœuvre to which the terms *cito tuto, et jucunde* can be so properly applied.

As to the alleged dangers of the method, my experience corresponds to that of Roemer,# of Zinstag,‖ of Fehling,△ and of Credé,◊ whose comparative sta-

* COHN, Zur Physiologie und Diätetik der Nachgeburtsperiode, Ztschr. f. Geburtshülfe und Gynaek., vol. xii, p. 381.

† DOHRN, Deutsche med. Wochenschr., 1880, No. 41.

‡ AHLFELD, Berichte und Arbeiten aus Giessen, 1881 and 1882.

ROEMER, Klinische Beobachtungen ueber der Nachgeburtszeit, Arch. f. Gynaek., vol. xxviii, p. 283.

‖ ZINSTAG, Beiträge zum Mechanismus der physiologischen Lösung der Placenta, Arch. f. Gynaek., vol. xliii, p. 255.

△ FEHLING, Zur Frage der Zweckmässigsten Behandlung der Nachgeburtszeit, Centralblatt für Gynaek., 1880, No. 25.

◊ CREDÉ, Die Behandlung der Nachgeburt bei regelmässigen Geburten, Arch. f. Gynaek., vol. xxxii, p. 96.

tistics show that Credé's method does not increase the quantity of blood lost either in the third stage or during the puerperium; that, unless resorted to at too early a period, it does not conduce to retention of the membranes; and that, even if this accident should occur, it does not, with rigid antiseptic conduct of labor, enhance the risks of puerperal infection.

In opposition to Schultze, Duncan maintains that when the mechanism of placental delivery is not interfered with by premature tractions upon the cord, the placenta descends edgewise through the cervix, and its expulsion is effected with the loss of but a trifling amount of blood. Of course it is understood that traction upon the cord is of common occurrence during the birth of the child, and that in consequence the Schultze method of descent is frequently enough met with. But Zinstag furnishes us observations in one hundred and thirty cases in which the cord was divided when coiled around the neck of the child immediately after the birth of the head, and in other cases during the passage of the breech. When this precaution was taken the mechanism of Schultze occurred in nine cases only; that of Duncan * with the placenta folded on the fetal surface in ninety-four cases; and in twenty-seven cases with the edge presenting but with the placenta folded upon the uterine surface, and with a certain amount of blood effused from the uterine sinuses between the folds and behind the membranes.

FIG. 124.—Showing normal descent of placenta. (Duncan.)

As a matter of practical importance, it is well to remember that when extraction is attempted previous to descent by pulling upon the cord, the central portion of the placenta is dragged into the cervix, while the borders are inverted in such a way as to form a cup-like cavity. This disturbance of the normal mechanism not only increases the difficulty of delivering the placenta, but causes the latter to exercise a suction force which increases the hæmorrhage, and at times even is capable of partially inverting the lax uterine walls. Now and then, where the occlusion of the cervix is complete, it may be found impossible to effect delivery without first introducing two fingers and hooking down the margin of the placenta, so as to allow air to pass above into the uterine cavity.

* MATTHEWS DUNCAN, Edinburgh Med. Jour., April, 1871.

Care of the Patient after Delivery.

As the danger of hæmorrhage does not always end with placental expulsion, the physician should be ready to sacrifice, even in simple cases, at least a half-hour to close observation of the subsequent behavior of the uterus. The weight of the hand laid above the symphysis pubis is usually sufficient to maintain a safe degree of retraction. Should, however, the uterus become lax, and lose its outline, the physician should grasp it in his hand and knead it firmly until a contraction is excited. In this way he not only guards against hæmorrhage, but, by preventing the formation of clots, he diminishes in multiparæ the severity of the after-pains.

Most physicians seek additional security against hæmorrhage by administering ergot, which, as is well known, favors tonic retraction of the uterus. To this there is no objection, provided the ergot be given subsequent to the expulsion of the placenta. When given, as is commonly done, at the time of the passage of the child's head, it is liable to produce its effect prematurely, and thus to give rise to hour-glass contraction. The rarity of the accident is no argument in favor of the popularity of the practice in the face of the serious complication to which it is capable of giving rise. When the physician judges it is safe to suspend the prophylactic pressure upon the uterus, he should see that all the soiled clothing be removed from beneath his patient, and that the nurse wash the genitalia gently but thoroughly. Nothing does so much to cause speedy disappearance of the soreness of the external parts as perfect cleanliness. In hospitals, a vaginal douche of warm carbolized water should be combined with external ablutions. The perinæum should then be carefully examined, and, if lacerations are discovered, the physician should make himself acquainted with their extent and importance.

Without entering into a discussion at this place of the methods of repairing perineal tears, it is proper to state that, both as a means of preventing infection and of promoting speedy convalescence, it is wise, in all cases where the laceration extends to or nearly to the sphincter ani, to bring the torn surfaces together by means of sutures. The technique is simple, and immediate union is the rule, if the same care is employed with regard to cleanliness that is usual in gynæcological practice. Rarely, failures to obtain union may result from syphilis, or from lowered vitality of the tissues due to extreme prolongation of the second stage of labor.

The application of the binder is one of those points in practice about which men of large experience entertain a difference of opinion. In my student days in the Hôpital des Cliniques in Paris the binder was dispensed with. A folded sheet was, however, laid across the abdomen, it having been found that a certain amount of pressure was

necessary for the comfort of the patient. This plan compelled her to lie upon her back, and thus had the disadvantage of restricting freedom of movement. Careful observation has failed, however, to show me a single good reason why the binder should be discarded. When properly applied, it adds greatly to the woman's comfort, and enables her to turn at will upon her side. My own preference is for a piece of unbleached muslin wide enough to reach below the hips.

In adjusting the binder, the physician should place himself to the right of the woman; he should seize the near end between the thumb and two fingers of the left hand, while with the right hand he draws the further portion smoothly over it. The two ends should then be held with the left hand, and the pins, which should preferably be of large size, should be inserted with the right. The process should begin below, and be followed upward at intervals of about two inches. These details are given because the writer remembers his own embarrassment arising from his inability to get information upon this trivial subject in the early days of his practice. Moreover, as many women are somewhat tenacious of having the binder first applied by the physician, to know how to do it with address is not an indifferent accomplishment. Many place a compress made of a folded towel above the symphysis pubis. This addition usually serves no better purpose than to displace the uterus to one side. The toilet of the patient is finally completed by laying a warm folded napkin at the vulva to receive the lochial discharge.

An aseptic dressing to the external parts is, however, warmly to be recommended in private as well as in hospital practice. This consists after washing the genitals thoroughly with a bichloride solution (1 to 3,000), in powdering the parts with iodoform, and then applying iodoform or bichloride gauze. The dressings should be held in place by an oakum pad. A little attention to these details possesses the immense advantage of preventing decomposition of the lochia and of promoting the healing of external wounds.

Anæsthetics in Midwifery.

The value of anæsthetics in certain irregularities of the labor-pains, in eclampsia, and in most midwifery operations, is no longer a matter of discussion. The benefits from their employment in such cases are palpable and beyond dispute. As to the right, however, of a woman to have her sufferings assuaged in ordinary normal labor, there is by no means unanimity of opinion. To be sure, the old objections raised in Sir James Simpson's day, that labor-pain is a salutary manifestation of life-force, that anæsthesia gives rise to paralysis, to peritonitis, to puerperal mania, to hæmorrhage, to pericardial adhesions, to indecencies of language and behavior, and that it contravenes the Word

of God, are now known to be unfounded or imaginary. Still, there is no doubt that the vast majority of medical men refrain from the use of anæsthetics in ordinary labor, either from vain apprehensions or because some incident in their practice has led them to suspect that, in spite of statistics, they are not devoid of objectionable or dangerous properties. In my own experience during the last sixteen years, there have been comparatively few cases in which I have not used chloroform or ether in some stage of labor. The result of my experience has been to make me a warm advocate of their wider employment on the one hand, while proclaiming the necessity of caution in their use upon the other. It seems to me that the hesitancy manifested regarding their general adoption is due, in large measure, to the fact that few practitioners give themselves the trouble to master the necessary *modus operandi*, to study the limitations of their usefulness, or to learn the conditions of their safe administration. It should be steadfastly borne in mind that the giving of anæsthetics in labor is an art to be acquired —a very simple one, perhaps, but the practice of which admits of neither ignorance nor carelessness.

As in ordinary surgical practice, anæsthetics are contra-indicated by organic affections of the heart and lungs.

Except in the prolonged insensibility required for difficult obstetrical operations, I think the preference should be accorded to chloroform rather than to ether. The former possesses the advantage of being more agreeable, more manageable, and more rapid in its action.

Anæsthesia, not narcosis, is the object aimed at, and the dulling of the sensibility is much more readily effected by chloroform than by ether.

As a rule, chloroform should not be administered during the first stage of labor, partly because of its tendency, when given at too early a period, to weaken the contractions of the uterus, and partly because protracted anæsthesia has a tendency to impair the cardiac force. To this rule there are, however, numerous exceptions, to which we shall have occasion to revert in connection with the consideration of irregular labor-pains.

If the pains in the second stage are of feeble intensity, it is best to withhold the anæsthetic; if of normal strength, chloroform may be given, but at first only in small doses and during the continuance of a pain. The anæsthetic should not be pushed to the stage of complete unconsciousness until the head begins to emerge at the vulva.

Chloroform can be conveniently given upon a folded handkerchief. The latter should be held near to, but not in contact with, the respiratory passages. The best diluent for chloroform, as was long ago stated by Sir James Simpson, is atmospheric air. If the handkerchief be laid directly across the nose, instant suspension of respiration may result.

A minor evil is the cutaneous irritation produced by placing the chloroform in direct contact with the lips and mouth.

At the beginning of each pain the patient should be directed to take a number of deep inspirations. During the acme of the pain the expiratory efforts which are then called into play prevent the inhalation of any considerable amount of the anæsthetic.

When the head presses upon the perinæum, the handkerchief should be intrusted to the nurse, but the administration to the end should be directed and strictly supervised by the physician.

When chloroform is first given, it is common for the pains to become weakened; but this suspensive influence upon the uterus is usually temporary. Exceptionally, however, the weakness of the pains may continue, and render it necessary to withhold the anæsthetic. In still rarer cases the pains remain inefficient after the anæsthesia has subsided. On this account it seems to me certain that those who use chloroform habitually will find themselves compelled to resort to the forceps with somewhat increased frequency. A tardy labor, due to uterine inertia, will likewise call for additional vigilance during the stage of placental expulsion to forestall the occurrence of hæmorrhage.

The immunity enjoyed by women in childbirth against the accidents which sometimes occur from anæsthesia in surgical practice is not absolute, but dependent upon its cautious and intelligent administration. I once narrowly escaped losing a patient in the Bellevue Hospital, upon whom I designed to perform version, in consequence of my house physician suddenly crowding a paper funnel containing a towel wet with chloroform over the respiratory passages.

Chloroform should not be given in the third stage of labor. The relative safety of chloroform in parturition ceases with the birth of the child. After delivery it favors the relaxation of the uterus and predisposes to hæmorrhage. Moreover, after the uterus has been emptied there is always an increase of blood in the large vessels of the abdomen, and a corresponding recession of blood from the head. Now, it is known that the quantity of chloroform which one day is perfectly tolerated by an individual in health may prove fatal on the succeeding day, in case of the intervention of any considerable loss of blood. Cerebral anæmia, from any cause, increases the risk of anæsthesia.

In lengthy operations requiring prolonged anæsthesia, ether, as has already been intimated, should be preferred to chloroform.

CHAPTER XII.

MULTIPLE PREGNANCIES AND THEIR MANAGEMENT.

Frequency.—Origin.—Varieties.—Acardia.—Weight.—Unequal development.—Superfetation.—Diagnosis.—Labor.— Presentations.— Simultaneous entrance of both children into the pelvis.—Locking.—Prognosis.—Conduct of labor.

THE term *multiple pregnancy* is used when more than one germ are simultaneously developed. Twins, the most common form, occur in the proportion of one to between eighty and ninety births; triplets in about the proportion of one to seven thousand; quadruplets and quintuplets are of extreme rarity. No authentic example of over five children at a birth is on record. An instance of quintuplets I have once witnessed. In the Prussian statistics of Von Hemsbach and Veit based upon thirteen million births, the number of twin pregnancies amounted to 150,000. Of these, in 50,000 both children were boys; in 46,000 both were girls; and in 54,000 the children consisted of a boy and a girl.

Twins may develop either from two distinct ova, discharged from the same or from distinct Graafian follicles, or may both originate from a single ovum. If two Graafian follicles rupture, the ovaries will offer two corpora lutea. In some instances a corpus luteum has been found in each ovary; in others both are situated in the same ovary.

In the case where twins develop from two ova, each fœtus is contained in its own chorion. If the ova are imbedded in the decidua at sufficiently distant points, the placentæ will be separate, and each ovum will have its distinct reflexa. If near one another, the placentæ are often united at their borders, each, however, maintaining its independent circulation. In some cases the two ova lie so close together that they are encircled by a common reflexa.

When twins are developed from two centers contained in the same ovum, the placenta, the chorion, and reflexa are, of course, common to both. In most instances each fœtus is contained in its own amnion. Occasionally, however, twins are furnished with but one amnion—a peculiarity which, in some cases at least, is not primary, but the result of an absorption of the party-wall between two originally distinct cavities.*

Twins from the same ovum are always of the same sex. Anastomoses of greater or less extent exist between the placental vessels of the two embryos. The consequences of these communications are of the utmost importance, for, when extensive, the heart's action in one

* AHLFELD, Beiträge zur Lehre von den Zwillingen, Arch. f. Gynaek., Bd. vii, p. 281.

fœtus counterbalances that of the other; the stronger blood-current in the placenta pushes back the weaker one, at first impeding the circulation of the less favored fœtus, then arresting it, and finally causing it to reverse its direction. The heart atrophies, and an acardia is produced, which is simply an appendage to the healthy fœtus. The circulation in the acardia takes place as follows: Venous blood from the healthy fœtus is conveyed by the umbilical arteries to the placenta; the force of the fetal heart drives the stream through the communicating

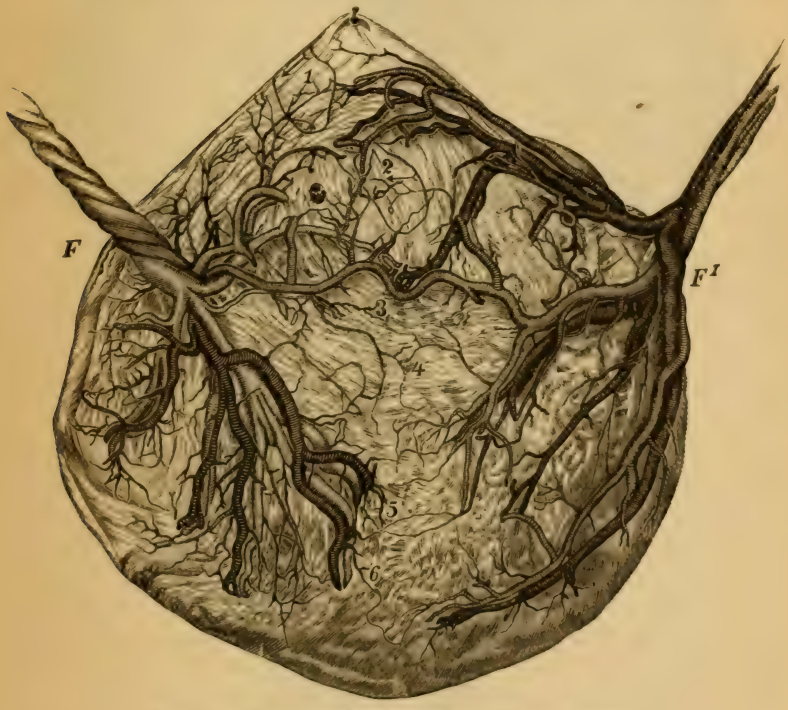


Fig. 125.—Twin placenta, showing arterial anastomosis.

branches to the umbilical arteries of the less favored twin; this force is, however, insufficient to carry the current to the upper parts of the body, which are, therefore, not developed. The favorable position of the lower extremities for receiving the blood from the umbilical vessels explains their continued though imperfect growth and development. The blood carried to the fœtus by the umbilical arteries is returned by the umbilical vein.

According to Ahlfeld,* a division may take place in the formative material contained within a single area germinativa. This division

* Ahlfeld, Die Entstehung der Doppelbildung und der homologen Zwillinge, Arch. f. Gynaek., Bd. ix, p. 196.

may be complete, and thus produce separate twins inclosed in the same amnion, which not only are of the same sex, but bear to one another through life the most striking similarity as regards appearance, physical peculiarities, and both mental and moral characteris-

FIG. 126.—Author's case of acardia. The monstrosity weighed three pounds nine ounces; there were no traces of heart, lungs, pancreas, liver, spleen, or sternum.

tics; or it may be incomplete, and thus give rise to conjoined twins, or one of the numerous forms of double monsters.*

In triplets, it is common to find one child derived from an independent ovum and two from a single ovum. In a case of quadruplets

* Schultze, on the other hand, contends that the double monsters are derived from the fusion of two embryos developed upon the blastodermic vesicle at points close to one another. SCHULTZE, Ueber Zwillingsschwangerschaft, Volkmann's Samm. klin. Vortr., No. 34.

reported by P. Müller,* two ova were simple, while the third contained two embryos. The children in the single ova were of the female, while those in the double ovum were of the male sex.

The average weight of the individual children in multiple pregnancies is less than that of children born single. This is partly due to the frequency with which the excessive distention of the uterus becomes the exciting cause of premature delivery, and partly to the obvious fact that the maternal organism is rarely capable of furnishing the nutritive material requisite for the complete growth of more than a single child.

Twins often exhibit at birth a remarkable disparity as regards both size and development—a disparity unquestionably due to local conditions. A striking example of this is shown in a case related by Schultze.† One child, at the time of delivery, was nearly if not quite, mature, while the other presented the appearances of a six weeks' fœtus. As both ova were enveloped in the same reflexa, their development must have begun at nearly the same time.

Sometimes one fœtus dies, and yields to the more fortunate brother the space and the nutritive material which would otherwise have fallen to his share. In such a case the ovum and the contained fœtus may be compressed by the surviving twin, and be flattened against the uterine wall, giving rise to the so-called "fœtus papyraceus"; or it may degenerate into a mole; or the aborted ovum may be expelled, while the living fœtus advances to the full term of gestation.

Very rarely, where the twins are both living but have undergone unequal development, the stronger child may be delivered first, while the other remains in the uterus, and is born after weeks of delay, during which, under more favorable conditions, it makes good the deficiencies due to its retarded evolution. The most remarkable cases of this kind occur in the uterus duplex. Professor Fordyce Barker related an instance in his practice where, in a double uterus, a mature living male child was born on the 10th of July, 1855, and on the 22d of September following the mother gave birth to a full-term living girl.

Histories like the foregoing are often adduced in support of the theory of what is known as superfetation—a theory which supposes that, after conception has once occurred, a second gestation may result from a subsequent coitus. That this is possible, if two ova are detached during the same menstrual period, seems to be established by authentic accounts of negro women giving birth to twins, showing the evidences of a paternity derived in one from the black and in the other from the white race. That impregnation can take place at two periods distant from one another must be regarded as an inadmissible

* P Müller, Eine Vierling's Geburt, Ztschr. f. Geburtsh. und Gynaek., Bd. iii. p. 166.

† Schultze, *loc. cit.*, p. 308.

hypothesis, until physiologists shall succeed in demonstrating in a single instance, by the presence of corpora lutea of different ages, that ovulation ever occurs during pregnancy.

Diagnosis.—The diagnosis of multiple pregnancy is rarely to be made out with absolute certainty. Unusual size of the uterus, with exaggeration of the symptoms which result from pressure, would naturally lead to inquiry on the part of the physician, as it is certain to excite apprehensions in the mind of the pregnant female. Size, however, furnishes but an uncertain criterion, as it may be equally due to the presence of a very large child, or to an excess of amniotic fluid. More trustworthy information is to be obtained from palpation and auscultation. Thus the recognition of a number of distinct fetal parts and the exclusion of hydramnion would render the diagnosis of twin pregnancy probable. The outlining of two fetal heads at a distance from one another would make the diagnosis certain. When the fetal heart is heard at two remote points, and the sound is found to die away in the intervening space, it is justifiable to conclude that the sound at each point has a separate origin. If the two heart-beats are counted at the same time by different observers, and are found not to correspond in frequency, a twin pregnancy is established beyond dispute. After the birth of the first child, the presence of the second is determined by the size and consistence of the uterus, and the perception of fetal parts both through the abdominal walls and the vagina.

The recognition of triplets and quadruplets is, of course, attended with even greater difficulties than that of twins.

Labor in Multiple Pregnancies.—We have already noticed the frequency of premature labor in multiple pregnancies. Of one hundred and ninety-two twin births reported by Reuss* from the Würzburg clinic, fifty-one did not complete the full term of gestation. In one of these abortion resulted from small-pox, in another from syphilis, in two cases premature labor was induced artificially, in the others labor occurred spontaneously—in one instance at the seventh month, in the other in the ninth or tenth months.

Twin labors are usually easy. The first child is delivered as in simple labors, and, except in faulty presentations, is followed shortly by the second. The interval varied, in seventy-four of Reuss's cases which terminated spontaneously, from five minutes to one and a half hour. In seventy-nine per cent the interval was less than an hour. As the stage of dilatation is completed at the time of the expulsion of the first twin, a protracted interval is occasioned purely by weakness and inefficiency of the pains.

The placentæ are usually expelled after the birth of the second child; now and then the placenta of the first child precedes the birth

* Reuss, Zur Lehre von den Zwillingen, Arch. f. Gynaek., Bd. iv, p. 123.

of the second; again, the second child may not be born until after the delivery of its placenta. When the placentæ are united, a portion may be torn off and expelled with the first child, while the remainder is not thrown off until after the birth of the second.* The placental stage is, owing to the relaxed state of the uterine walls, apt to be of longer duration than in simple labors, and calls for the exercise of special care to guard against the occurrence of hæmorrhage.

FIG. 127.—Twin pregnancy, both heads presenting. (Tarnier et Chantreuil.)

Presentations in Twin Labors.—Spiegelberg† furnishes the following table, derived from 1,138 deliveries, of which 899 were taken from Kleinwächter and 203 from Reuss:

Both heads presenting	558,	or 49	per cent.
Head and breech presenting	361,	" 31·7	"
Both pelvic presentations	98,	" 8·6	"
Head and transverse presentations	71,	" 6·18	"
Breech and transverse	46,	" 4·14	"
Both transverse	4,	" 0·35	"

* *Vide* SPIEGELBERG, Lehrbuch der Geburtshülfe, Bd. i, p. 203. † *Ibid.*

The transverse presentations are mostly secondary, consequent upon the roominess of the uterine cavity and the sudden escape of the amniotic fluid. Version is, of course, in such cases easily performed.

The Simultaneous Entrance of Both Children into the Pelvis.—The consideration of the various complications to which this anomaly gives rise belongs to the domain of pathology. To avoid, however, needless repetitions, they may, for convenience' sake, be properly considered in the present connection.

When both children present at the brim previous to the rupture of the membranes, it usually happens that, with the escape of the amniotic fluid, one of the twins descends into the pelvis, while the second glides to one side. The result is identical, whether the twins are contained in a single or in separate sacs. If interference is called for because of delay, the amnion, or one amnion in case there are two, should be ruptured, and the nearest presenting part brought into the pelvis, while the other is at the same time pushed out of the way. If head and breech present, the head should preferably be allowed to descend first.

It may happen, however, that after rupture both children may descend into the pelvis so close to one another as to hinder each the other in its further progression. This locking of the twins, as it is termed, may take place in one of two ways, viz. :

1. In double vertex presentations, delivery may be impeded by the pressing of the second head into the neck of the more advanced fœtus, or, after the birth of the first head, the second may enter the pelvis and arrest the advance of the thorax. Obviously this difficulty could only arise in a case where both heads were of unusually small size. The diagnosis has rarely been made previous to the birth of the first head. The treatment consists in the artificial extraction of one head after the other, and then delivering the body of the first child. Craniotomy is usually not necessary. The prognosis as regards the children is extremely unfavorable. Reimann * reports six cases in which the fate of the children was known. Of the six first-born, one survived; of the six last-born, two survived. Reimann, in commenting on these figures, remarks: "The child whose head first enters the pelvis is in great danger, because not only is its neck squeezed by the head of the second child, thereby producing cerebral hyperæmia, but its umbilical cord is exceedingly liable to be compressed by the body of the second child."

2. When one child presents by the breech, the other by the vertex, the former, because of its smaller size, is apt to descend first into the pelvis. No difficulty is then experienced until the neck is born. In case, however, meantime the head of the second child has entered the

* Reimann, Am. Jour. of Obstet., 1877, vol. i, p. 58.

pelvis, further progress may be rendered impossible, a lock resulting either from the overlapping of the chins, or of the occipital portions of the two heads, or from the pressure of the face of one child into the neck beneath the occiput of the other. By lifting the body of the child, and introducing the half-hand into the vagina, the diagnosis is rendered easy.

In a large, roomy pelvis, if the pains are good and the children small, spontaneous delivery may take place. In a number of cases of

Fig. 128.—Twin pregnancy, head and breech presenting. (Tarnier et Chantreuil.)

this kind which have been reported, the head of the second child was born first. In a few instances it has been found possible to push up the second head. Operative measures consist in applying the forceps and extracting the second head, and afterward, if necessary, the first. In case of failure, craniotomy remains as an ultimate resort. The first child is rarely born living. Of twenty-six children, the fate of which was ascertained by Reimann, only three survived. The prognosis of the second child is more favorable. Of twenty-nine cases, Reimann reports nineteen survivals. Naturally, therefore, the perforation of

the first head would be preferred, were the matter one purely of election, but the operation is very difficult, and does not remove the obstacle, for even the diminished head can not pass the one already occupying the pelvis.* In the cases so far reported, where decapitation of the first child has been performed, the operation has not proved successful in saving the life of the second.

The possibility of one twin sitting astride the other, when transverse, requires mention, because of the perplexity that may arise as to the diagnosis, unless the hand is introduced into the lower segment of the uterus to determine the exact relations of the twins to one another.

Prognosis.—The prognosis, both as regards the children and the mother, is much more unfavorable than in simple labors. Statistics on this point are valueless, as much depends upon the conduct of the physician. As regards the children, the increased mortality results from prematurity, from unequal development, and from the frequency of malpositions and malpresentations, requiring operative interference. As regards the mother, the mortality and susceptibility to puerperal diseases are augmented by the excessive distention of the uterus, the extent of the placental wound, the feebleness in many cases of uterine retraction after delivery, and by the operations which grow out of the anomalies to which labor in multiple pregnancies is subjected.

Conduct of Labor in Multiple Pregnancies.—The management of multiple pregnancies does not differ essentially from that of ordinary labor. After the birth of the first child, the placental end of the cord should in all cases be tied, on account of the frequency with which anastomoses are found between the vessels of the placentæ. A period of repose should then be allowed, to enable the uterus to retract down upon the remaining ovum. During the birth of the second child, every care should be taken to follow the uterus with the hand, and redoubled precautions should be observed against the occurrence of hæmorrhage, to which the woman is exposed both on account of the large size of the placental wound and the disposition to relaxation. In case the second child presents by the shoulder, version by external manipulations alone is usually practicable. Expression should be employed to force the placentæ into the vagina. When both descend at once, if it is necessary to make tractions, both cords should be drawn upon, simultaneously or in alternation, to find which placenta is most easily removed. When one placenta follows the birth of the first child, it should be left untouched until the advent of the second. Vigilance after delivery should be long observed.

We have already noticed that the length of time between the expulsion of twins situated in separate membranes rarely exceeds an hour. When, therefore, there is a longer delay in the delivery of the

* Reimann, *loc. cit.*, p. 61.

second child, measures should be employed to excite pains, and the membranes should be ruptured. In case of a premature child delivered with its own placenta, cases of continued development, *in utero*, of the remaining child, would point to the policy of abstention. In instances where more than two children are contained in the uterus, the anomalies of position are more frequent, and the danger of hæmorrhage is still further enhanced.*

* Spiegelberg, Lehrbuch, pp. 206, 207.

THE PUERPERAL STATE.

CHAPTER XIII.

THE PHYSIOLOGY AND MANAGEMENT OF CHILDBED.

The puerperal state borders closely upon pathological conditions.—Post-partum chill.—Temperature.—The pulse.—General functions.—Retention of urine.—Loss of weight.—Involution.—Separation of the decidua.—Closure of the sinuses.—The cervix.—The vagina.—Position of uterus.—After-pains.—The lochia.—The secretion of milk.—Anatomical considerations.—Milk-fever.—Composition of milk.—Diagnosis of the puerperal state.—The new-born infant.—Changes in circulation.—The navel.—Tumor upon the presenting part.—Digestion.—Skin.—Icterus.—Loss of weight.—Management of puerperal state.—Sleep.—Passing urine.—Visits of physician.—Washing the vagina.—Diet.—Laxatives.—Nursing.—Duration of lying-in period.—Care of new-born infant.—Bath.—Cord.—Nursing.—Wet-nurses.—Artificial feeding.

THE puerperal state occupies the border-land between health and disease. Though in a strict sense physiological, it offers a variety of conditions, as Schroeder * has pointed out, which at other times, and under other circumstances, would be regarded as pathological. Thus, the exfoliation of the decidua, and the copious serous transudation, with the abundant formation of young cells which accompanies the development of the new mucous membrane, would elsewhere be regarded as characteristic features of catarrhal inflammation. The acute degeneration of the uterus presents a phenomenon which, when repeated in any other organ of the body, would prove speedily fatal. The thrombus formation in the open placental vessels possesses no corresponding physiological analogue. Again, the torn vessels may lead to hæmorrhage, while the traumata which even in normal labor result from parturition, the ease with which deleterious materials are absorbed by the wide lymphatic interspaces, the serous infiltration of the pelvic tissues, the exaggerated size of the lymphatics and veins, create a predisposition to innumerable forms of disease. The nicety of the balance between normal and morbid conditions renders it peculiarly necessary for the practitioner to make himself familiar with the physiological limits of the phenomena of childbed.

Post-partum Chill.—The exertion of labor is followed by a sense of comfort and repose. Often, after the birth of the child, a chill sets in

* SCHROEDER, Handbuch der Geburtshülfe, 6te Aufl., p. 216.

of greater or less intensity, but of short duration, and of no prognostic importance. It is to be accounted for by the disturbance of the equilibrium between the internal temperature and that of the external surface. Thus, toward the end of labor, and for a short period subsequent to delivery, the loss of heat is increased by the evaporation from the lungs and skin and the cessation of muscular effort. This cooling process is, however, speedly arrested by the contraction of the cutaneous arterioles. During the period which intervenes until the external and internal temperatures rise to relatively equal levels, the patient experiences chilly sensations, or a distinct, well-defined chill.* This phenomenon is more frequent in hyperæsthetic women and in those whose skins are bathed in profuse perspiration, especially where there has been some necessary exposure of the person during the expulsion of the head or of the placenta. Under the influence of a warm, dry bed, the chill at once subsides.

Temperature.—As a rule, it may be stated that the temperature range in normal childbed does not differ materially from that which prevails in non-puerperal conditions.† Still, a rise of temperature following the parturient act, averaging one and a half degree in primiparæ and one degree in multiparæ, is not uncommon. This elevation may continue during the first six days, with, however, morning remissions and slight evening exacerbations. It is most pronounced in the first twelve hours, especially when they coincide with the normal evening increment. In the following days the highest point is usually reached at five in the afternoon, while the lowest temperature is found in the night hours between eleven and one. A sub-febrile temperature of 100½° has no prognostic significance. A temperature rise above 100½° is by no means incompatible with a generally satisfactory condition of the patient. Among the provoking causes of increased heat production may be reckoned prolonged labor, fecal impaction, mental excitement, the reaction of small wounds in the course of the genital canal, and the disturbances attendant upon the establishment of lactation.‡

The Pulse.—In contrast to the increase in the temperature, the pulse often exhibits a remarkable diminution in frequency, in perfectly normal cases ranging between sixty and seventy beats, but not unfrequently dropping to a still lower level, and may even sink to less than forty pulsations in the minute. This slowing of the pulse is of favorable prognostic import. It is known to be associated with diminished

* Fehling, Klin. Beobachtungen über den Einfluss der todten Früchte auf die Mütter, Arch. f. Gynaek., Bd. vii, p. 151.

† Temesvary and Bäcker, Studien aus dem Gebiete des Wochenbettes, Arch. f. Gynaek., vol. xxxiii, p. 331.

‡ *Vide* Schroeder, Schwangerschaft, Geburt und Wochenbett, pp. 168–177; Spiegelberg, Lehrbuch, p. 210.

arterial tension,* and has been attributed to a variety of not very satisfactory reasons, such as the sudden removal of the utero-placental vessels from the circulation, entailing a less degree of labor upon the heart, repose in bed, and disturbed action of the pneumogastric nerves. It is usually most marked on the second or third day, and does not appear to be specially influenced by the establishment of lactation.

General Functions.—During the first week the skin is active and moist; the patient is, therefore, sensitive to temperature changes, and is subject to profuse perspiration when warmly covered or during sleep. The appetite is lessened, the thirst is increased, the bowels are sluggish, and the urine abundant. In spite of the light diet and repose in bed, the amount of urea eliminated is but slightly diminished. Sugar in the urine is observed at the time of the establishment of lactation. It disappears soon afterward, to reappear, however, whenever the milk production is in excess of its consumption.† The diabetes is, therefore, due to absorption.‡

Retention of Urine.—In the first day or two following confinement, retention of urine is a common occurrence. It results, according to Schroeder, from the increased capacity of the bladder following the removal of pressure from the gravid uterus. Many women who suffer from retention when reclining are able to voluntarily urinate when raised to a sitting posture, probably because of the greater facility with which, in the latter case, the pressure of the lax abdominal parietes can be exerted upon the bladder.

Loss of Weight.—Owing to the rapid retrograde changes in the pelvic organs, the discharges from the genital passage, the increased secretions of the skin and kidneys, combined with limited ingestion of food, the loss of weight in the first week amounts to from nine to ten pounds, or, roughly speaking, to about one twelfth the weight of the body.#

Involution.—The processes by means of which the uterus returns to its non-puerperal condition are inaugurated at the commencement of labor. During the rapidly following contractions of the uterus there is, on the one hand, waste of tissue substance, engendered by the work performed, while on the other, the compression of the nutrient vessels diminishes the supply of reparative material. As a result of this disturbed equilibrium, there ensues a fatty degeneration of the protoplasm of the muscle cells. This process continues after the expulsion of the ovum. At the same time, the individual muscular cells shorten and

* Meyberg, Ueber die Pulse der Wöchnerinnen, Arch. f. Gynaek., Bd. xii, p. 114.

† Johannovsky, Ueber den Zuckergehalt im Harne der Wöchnerinnen, Arch. f. Gynaek., Bd. vii, p. 448.

‡ Spiegelberg, *loc. cit.*, p. 212.

Gassner, Monatsschr. f. Geburtsk., Bd. xix, p. 47.

broaden, while transverse and longitudinal ridges form upon them. In this way, and by the absorption of the superfluous protoplasm, the muscular cells are gradually reduced to normal dimensions. In from six to eight weeks the process described reaches its completion. The lochia then cease, and, in women who do not nurse, menstruation returns.

The view maintained by Heschl, which long received the support of obstetrical writers, was in effect that subsequent to labor the entire muscular tissue of the uterus underwent fatty degeneration, and that the oxidized products were gradually absorbed. Meantime, a new formation of muscular cells, beginning upon the periphery of the organ, about the fourth week, took the place of the old elements. In accordance with this view, it has been customary to state that with the end of each pregnancy the old uterus was destroyed, and that a new organ was built up upon its ashes. Kölliker admitted a partial destruction and a partial new formation of muscle cells, but held that the greater number of the enormously enlarged cells of pregnancy did not entirely disappear.

The view we have given is that defended originally by Luschka and Robin. In studies preparatory to his work on Cæsarean section, Sänger was perplexed to see how union of cut surfaces could be secured by means of suture if the theory of simultaneous acute fatty degeneration should be proved correct. Careful observations made by him upon this point seem to settle the question in favor of the more conservative natural process.*

Immediately after birth the uterus weighs upward of two pounds. The peritoneal surface is covered with transverse, oblique, and longitudinal ridges, and furrows corresponding to the direction of the underlying muscular bundles. In two days the weight falls to a pound and a half; the uterus is seven to eight inches in length, and about four and a half inches broad; the walls are from an inch to an inch and a half in thickness. At the end of a week the uterus weighs a pound, and is five to six and a half inches long. At the end of two weeks the weight is three fourths of a pound, the length five inches, and the walls hardly a half-inch in thickness. Of course, the individual variations from these averages are very great.† In six weeks the process usually reaches the end, though the uterus remains ever after somewhat larger and more rounded than in nulliparæ—a change due chiefly to an increase of connective tissue.

Repair of the Decidua.—With the expulsion of the ovum the outer portion of the decidua vera for the most part adheres closely to the reflexa, while the meshy portion, with the fundi of the glands, remains attached to the uterus. The adherent portion consists of empty areolar spaces, of gland septa, of lymphatic spaces and blood-vessels, while

* *Vide* The Involution of the Muscular Tissue of the Puerperal Uterus, by Dr. M. Sänger, Annals of Gynæcology, Boston, July, 1888.

† Börner, Ueber den puerperalen Uterus; Sinclair, Measurements of the Uterine Cavity, Trans. of the Am. Gynæc. Soc., vol. iv, p. 231.

only the fundal extremities are lined with glandular epithelium.* As, however, the line of demarkation rarely takes place throughout the entire decidua at any fixed level, fragments of the outer, more compact layer may frequently be found here and there clinging to the inner surface of the residual membrane.†

The uterine cavity is covered and in part filled with at first a bloody and subsequently a muco-sanguinolent fluid containing blood and mucus corpuscles, and decidua-cells in various stages of degeneration.

At the end of a week the mucous membrane measures at most from a half to three quarters of a line in thickness; the inner surface has become smoother from the disintegration and exfoliation of adherent shreds; the glands, owing to diminished size of the uterus, are pressed closer together, and assume a more nearly perpendicular direction; the gland-epithelium extends upward along the gland-walls to the surface of the membrane; the interglandular spaces are filled with lymphoid cells, with blood-corpuscles, fat-granules, and epithelial cells, in a state of fatty degeneration. As the regenerative process goes on, fine capillaries without walls form in the interglandular substance, so that the latter presents the appearance of granulation-tissue. By the third week these vessels of new formation stretch upward to the surface of the mucous membrane, and by the sixth week the development of the vascular network is complete. In the second week the lymphoid cells begin to dissolve, and thus the glands are brought into near contact with one another. Spindle-shaped cells of young connective tissue are found between the glands in the second week, and with continued connective-tissue proliferation the flattened tubules are drawn upward, and assume a perpendicular direction. The epithelial cells at the mouths of the glands, which at first formed separate islets, approach one another as the glands assume their normal positions, and by actively multiplying spread from the circumference until they form a continuous lining to the wounded surface.

As regards the principal features, the changes which take place at the placental site are the same as those described elsewhere within the uterine cavity. Immediately after delivery, however, the surface possesses an uneven aspect, with elevations where the septa of the serotina had penetrated between the placental cotyledons, and with intervening depressions. The mouths of the torn vessels are closed by thrombi, and large vessels are irregularly distributed beneath the attached residue of the mucous membrane. The process of regeneration at the placental site takes place somewhat more slowly than elsewhere within the uterus.

* Leopold, Studien über die Uterusschleimhaut, etc., Arch. f. Gynaek., Bd. xii, p. 180.

† Küstner, Die Lösung der mütterlichen Eihäute, Arch. f. Gynaek., Bd. xiii p. 422.

Closure of the Sinuses.—By the eighth month of pregnancy, as has been mentioned, a portion of the sinuses beneath the placenta are obliterated by the emigration of giant-cells which cause coagulation of the blood circulating through them. After delivery, the blood stagnates in the intact vessels in such a way that at first the inner walls are covered with fibrin, while the center contains fresh red blood. The walls then thicken by proliferation of the endothelium, and lymph- and blood-corpuscles penetrate into the coagulated layer. Finally, the thrombus fills the entire vessel, spindle-shaped cells radiate from the endothelium, and with the development of young connective tissue a gradual shrinkage takes place, which, however, proceeds slowly, so that four to five months after birth the placental site is still distinguishable.* According to Engelmann, pigmentary deposits in the tissue of the mucous membrane are almost conclusive evidence of recent delivery, as after menstruation they are not found, probably on account of the superficial character of the hæmorrhage.

The Cervix.—After delivery the cervix speedily resumes its normal size. At first it has a soft and pulpy feel. The os internum forms a resistant ring, which constitutes a well-defined boundary between the corpus and cervix uteri. This ring varies in size in different subjects, but is always sufficiently open to permit the introduction of two fingers. Beneath, the walls are thrown into transverse and longitudinal folds. The os externum is usually torn, especially upon the sides, and the thickened labia roll outward. The length of the canal measures two and three quarters inches and upward. At the end of twelve hours the distinction between the cervix and vagina is clearly marked, and the os internum is so far closed that a certain amount of force is requisite to pass two fingers into the uterine cavity. The contraction of the os internum renders the longitudinal folds more pronounced in the upper portion of the canal. From this time on, the involution of the cervix advances rapidly. At the end of twelve days the canal is shortened to an inch in length. As the longitudinal muscles contract, the plicæ palmatæ become distinct as transverse ridges. The longitudinal folds, with the exception of the anterior and posterior ridge which belong to the plicæ palmatæ, disappear with the retrograde changes which take place in the mucous membrane. The os externum long remains patulous, and permits the finger to pass to the os internum for a period varying between the seventh and fourteenth days. The anterior lip is thicker than the posterior, and is frequently the seat of erosions and granulations. The involution of the vaginal

* Leopold, Studien über die Uterusschleimhaut, etc., Arch. f. Gynaek., Bd. xii, p. 169; Engelmann, The Mucous Membrane of the Uterus, Am. Jour. of Obstet., May, 1875; Spiegelberg, Lehrbuch, p. 214; Schroeder, Lehrbuch, p. 222; Küstner, Die Lösung der mütterlichen Eihäute, etc., Arch. f. Gynaek., Bd. xiii, p. 422; Friedländer, Arch. f. Gynaek., Bd. ix, p. 22.

portion is not completed until after the expiration of five to six weeks.*

The Vagina.—The vagina during the first few days is soft, smooth, and relaxed, and requires from three to four weeks to regain its normal dimensions. The contraction and involution proceed more rapidly at the introitus than above in the neighborhood of the fornix, though, owing to the presence of lacerations, it remains, with few exceptions, permanently wider than in women who have never borne children.

Position of the Uterus.—Immediately after the expulsion of the placenta the contracted uterus is felt through the abdominal walls as a firm, solid body, of a flattened, pyriform shape. When both hips are on the same level, and both bladder and rectum are empty, the uterus is found in the median line with the fundus between the symphysis and the navel. At the same time the weight of the body and the laxity of the abdominal walls lead to a moderate degree of anteflexion. Urine in the bladder and fæces in the rectum give rise to a certain amount of lateral displacement, and now and then to a torsion of the uterus upon its long axis. As in pregnancy, the fundus of the uterus is thus generally, though not always, directed to the right, and the left border looks to the front. The mean elevation of the fundus above the symphysis is about four and one third inches, the width of the fundus is upward of four and a half inches, and the length of the entire uterine cavity, as measured by the sound, is in the neighborhood of six inches. The dimensions of the uterus are somewhat less in primiparæ than in multiparæ. A full bladder pushes the fundus upward, and increases the longitudinal diameter of the organ. Börner has observed an increase from this cause amounting to three and a half inches.

A diminution in the size of the uterus is apparent in most cases in the course of the first twenty-four hours. An actual increase is either pathological, or due to the above-mentioned influence of the bladder. The diminution is most marked in the first twenty days, but afterward progresses at a slow rate. About the tenth day the fundus sinks below the level of the symphysis pubis, and the posterior surface of the anteflected uterus occupies the plane of the brim.†

After-Pains.—The reduction of the uterus in the first few days of

* Lott, Zur Anatomie und Physiologie der Cervix Uteri, pp. 87 *et seq.* Börner, Ueber den puerperalen Uterus, p. 47, states that at the end of the second week the os internum permits the passage of the finger in about half the cases, but is closed in all by the end of the third week.

† Börner, *loc. cit.*; Credé, Beiträge zur Bestimmung der normalen Lage der gesunden Gebärmutter, Arch. f. Gynaek., Bd. i, 1870, p. 84; Pfannkuch, Ueber die Einfluss der Nachbar-Organe auf die Lage und Involution der puerperalen Uterus, Arch. f. Gynaek., Bd. iii, 1872, p. 327.

the childbed period is in the main the result of contractions, termed after-pains, resembling those of labor both as regards the hardening of the uterine walls perceptible through the abdominal coverings, and the nature of the dolorous sensations which they evoke. The after-pains stretch over a period varying from one to four days. Their duration and intensity are in inverse proportion to the duration and activity of the preceding labor. On this account they are more pronounced in multiparæ, while they are often absent subsequent to a first delivery. They are intimately associated with the permanent retraction of the uterus, and are therefore to be regarded as a normal and favorable phenomenon. They are especially prominent in cases of overdistention of the uterus, as, for instance, in cases of twin pregnancies and hydramnios. Suckling the infant produces reflex contractions of a somewhat intense character.

The Lochia.—The discharges from the genital passage consequent upon delivery are termed the lochia. At first the latter are composed of pure blood with coagula of fibrin, but after a few hours the wounded surface of the uterus furnishes an abundant exudation of a serous, alkaline fluid, which washes away in its descent the secretion from the cervix and the vaginal mucus. For the first two or three days the lochia are of a red color (*lochia rubra*) from the commingling of blood, while upon the third, fourth, and sometimes upon the fifth day, as the sanguineous elements diminish, they present a pale-red color (*lochia serosa*). As constituents, we find under the microscope cervical and vaginal epithelium, blood and mucus corpuscles, bits of decidua, and sometimes shreds of membranes and of the placenta. The organic constituents consist of albumen, mucine, the saponified fats, and a variety of saline matters. From the fifth to the seventh or eighth day the discharge continues thin, but the blood-corpuscles become less abundant, while there is an increase in leucocytes and fatty globules. In the second week the discharge becomes of a grayish-white or greenish-yellow color (*lochia alba seu lactia*), and of a creamy consistence. It contains chiefly leucocytes, young epithelial cells, spindle-shaped connective-tissue cells, fat-granules, free fat, and crystals of cholesterine. The reaction is neutral or acid. Gradually the discharge diminishes, becomes transparent, and finally assumes a normal appearance. The vaginal lochia in the rule are found to contain a variety of micro-organisms, such as the diplo- and strepto-cocci, rod bacteria, the trichomonas vaginalis, and sometimes gonococci. They vary greatly in quantity, and increase in abundance with the advance of the puerperal week. They are derived in part from germs present in the vagina previous to confinement, and in part obtain entrance through the vulva. In the vagina the conditions for their development are peculiarly favorable. The number can be greatly limited by hygienic measures. When they obtain access to the uterine cavity their power for evil is greatly augmented. Toward

the end of the first week, and, especially after leaving the bed, fresh blood often makes its appearance.*

The quantity of the lochia varies with the peculiarities of the individual. It is, as a rule, greater in multiparæ, in women who do not nurse their children, and in those of flabby fiber, who habitually menstruate abundantly. The mean quantity, according to Gassner, of the lochia cruenta or rubra (to fourth day) amounts to nearly two and a fourth pounds; of the lochia serosa (to sixth day) to rather more than nine ounces; and of the lochia alba (to ninth day) to six and two thirds ounces; so that the entire amount lost during the first eight days reached the total amount of nearly three and a quarter pounds.

The Secretion of Milk.

Anatomical Considerations.—The breasts, which furnish the secretion of the milk, are two large glands of the compound racemose variety. They are covered by a fine, supple skin and a layer of adipose

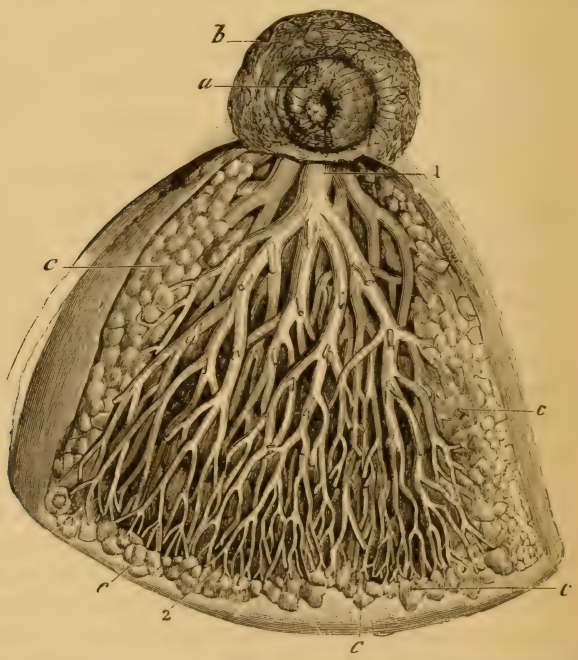


Fig. 129.—Mammary gland. *a*, nipple, the central portion of which is retracted; *b*, areola; *c*, *c*, *c*, *c*, lobules of the gland; 1, sinus, or dilated portion of one of the lactiferous ducts; 2, extremities of the lactiferous ducts. (Liegeois.)

tissue, which increases in thickness toward the periphery of the organ. The mass of the glandular substance is composed of from fifteen to

* *Vide* Schroeder, Lehrbuch, etc., 6te Aufl., p. 226; Spiegelberg, Lehrbuch, p. 218.

twenty-four lobes, which in turn are subdivided into lobules made up of a greater or less number of acini, or *culs-de-sac*. Fine canaliculi start from the latter, and unite together to form the canals of the lobules. These again anastomose, to form a principal canal for each lobe, termed the lactiferous duct. The lactiferous ducts terminate at the nipple by small openings measuring only from one sixtieth to one fortieth of an inch. Each duct, as it passes downward, enlarges in the nipple to one twenty-fifth or one twelfth of an inch in diameter, and beneath the areola it presents an elongated dilatation, from one sixth to one third of an inch in diameter, called the sinus of the duct (Flint). The spaces between the lobes are filled with adipose tissue, and the various elements which constitute the mammary glands are united into a single mass by a dense connective tissue continuous with that of the subcutaneous layer. The acini, which are merely rudimentary in the non-pregnant state, are lined with a single layer of small polyhedral cells, assuming a more cylindrical character in the neighborhood of the canalicular ducts. The main ducts are lined with low cylindrical cells, and contain in their walls non-striated muscular fibers, the contractions of which are the cause of the spurting of the milk in lactation.

During pregnancy the breasts enlarge in consequence of the swelling and increase of the connective tissue, the accumulation of fat between the lobes, and the multiplication of the acini, which fill with fatty globules resulting from the disintegration of the lining epithelial cells. The changes in the secretory apparatus give rise to irregularly distributed nodular cords, which, however, at first are most distinct at the periphery, and thence advance toward the center of the organ. With continued development a lactescent fluid is produced, which either exudes spontaneously from the nipple or is discharged by pressure.

Milk-Fever.—About the third or fourth day of the childbed period the turgescence of the breasts is suddenly increased, and they become full, tense, nodular, and sensitive to the touch. The axillary glands enlarge, and radiating pains are experienced in the arm and shoulder. The intensity of the mammary congestion varies in different individuals. It is more pronounced in women who postpone nursing their children until after the secretion of milk is fully established. In exceptional cases it may be absent altogether. Since the general introduction of the thermometer into practice, and the better understanding of the causes of febrile temperatures in the puerperal state, the existence of a distinct milk-fever referable to functional disturbances in the breasts during the period in question has been found to be an entirely exceptional occurrence. The temperature tables which have been kept with great regularity for the past ten years in the Maternity Hospital of this city prove that, under normal conditions, the tempera-

tures of the third day do not rise above 100½°. With this sub-febrile increase there is, indeed, often conjoined considerable general disturbance, indicated by slight chilly sensations, headache, anorexia, and a quickened pulse, which, however, disappear in the course of twenty-four hours, with profuse perspiration, and an abundant secretion of milk. Most writers regard the higher temperatures which are sometimes found associated with extreme turgescence, tenderness, and

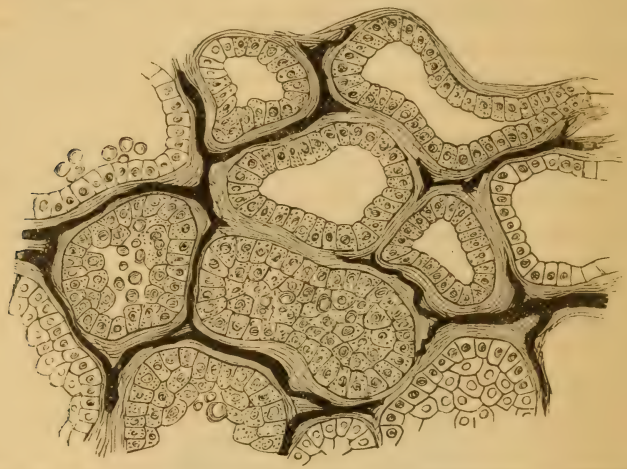


Fig. 130.—Section through acinus from breast of a nursing woman. (Billroth.)

reddening of the mammæ, and which subside when the latter are partially unloaded, as dependent upon a non-suppurative form of parenchymatous inflammation.

Composition of Milk.—Milk is composed of a fluid portion and of formed constituents, the first derived from the blood, and the second, termed the milk-globules, from the epithelial contents of the acini. In the production of the milk-globules the gland-cells actively multiply, and become filled with granular particles, which gradually coalesce to form drops of fat. Subsequently the nuclei and the contours of the cells disappear, so that the latter consist of mulberry-shaped aggregations of fat-drops held together by the remains of the cell-protoplasm. The epithelial elements thus metamorphosed are termed colostrum-corpuscles. They are found sparingly distributed in the crude, imperfectly formed secretion known as colostrum, which is furnished by the breasts of women who have been but recently confined. Finally, the fat-globules of large and small size separate from one another, and form an emulsion with the fluid transuded from the blood, a process aided, according to Kehrer, by the diffusion through the fluid of the residual protoplasm of the cells.*

* Kehrer, Zur Morphologie des Milch-Caseins, Arch. f. Gynaek., Bd. ii, p. 1.

Colostrum is a watery, semi-opaque, mucilaginous fluid, containing yellowish streaks composed of fat-globules and fatty-degenerated cells which hang together in stringy masses. It is distinguished from true milk not only in the physical characteristics mentioned, but in the greater proportion of sugar and inorganic salts it contains, and in the fact that it coagulates upon boiling. It possesses laxative qualities, which render it of use to the infant in aiding the removal of the meconium.

Perfectly formed milk contains from 2·5 per cent to 7·6 per cent butter in emulsion, and from 3·2 per cent to six per cent milk-sugar in solution. Both of these substances are directly manufactured by the gland-structures. It possesses likewise a protein substance termed casein, which fluctuates in quantity between one, three, and four per cent. Kehrer maintains that it is not held in the milk in solution, but is composed of particles derived from cell-protoplasm which are diffused through the fluid. The salts in the milk amount to 0·14 per cent.*

The Diagnosis of the Puerperal State.—The diagnosis of recent delivery is based upon the physiological conditions which, we have seen, characterize the puerperal state. Thus, the abdomen is flabby and wrinkled, with pigmented linea alba, and is traversed by white and red lines; the breasts are full, tense, and nodular, and secrete milk or colostrum; the areola about the nipple is discolored; the uterus is enlarged, anteflexed, palpable through the abdominal wall, and is excited to contract by pressure; the vulva is swollen, the labia gape apart, the hymen is ragged, the perinæum is distensible, and in recent cases lacerations, in older ones ulcers or granulating wounds, are found about the vaginal orifice; in the smooth, lax vagina there is observable the absence of the columnæ rugarum; the cervix is soft, wide below and narrowing above, with the labia often torn and contused; when the finger can be passed into the uterine cavity, thrombi may be felt at the placental site; finally, the lochia are hardly likely to be confounded with hæmorrhages or discharges from non-puerperal causes.

During the first two weeks an approximative estimate may be made as to the date of confinement by bearing in mind that just after delivery colostrum is found in the breasts, the lochia are bloody, and the lacerations about the vulva present a fresh appearance; that during the following days the lochial secretion changes first to a serous and then to a purulent character; that the uterus gradually diminishes in size, the fundus at the tenth day sinking below the upper border of the symphysis, while the os internum remains patulous to the tenth day, and is usually impassable for the finger after the twelfth day.

* Spiegelberg, *loc. cit.*, p. 221.

The New-born Infant.

With the first inspiration the thorax expands and air fills the alveoli of the lungs; at the same time the blood passes from the right side of the heart to the capillaries of the pulmonary organs, and is returned arterialized to the left side of the heart. As a consequence of the establishment of the pulmonary circulation, the ductus arteriosus contracts, the foramen ovale closes, and the left ventricle undergoes eccentric hypertrophy. With the diversion of a part of the blood-currents to the lungs, the pressure in the aorta sinks, and the circulation in that portion of the umbilical arteries which lies outside the navel ceases, while thoracic aspiration empties the umbilical vein. The cord dries from the cut surface toward the navel, and drops off on the fourth or fifth day. The line of demarkation forms at the termination of a capillary network which extends upward upon the cord to a distance of from three to four lines from the skin. When the cord drops off, a wounded surface is left, which heals in a few days.

The swelling upon the presenting part subsides mostly in twenty-four to forty-eight hours. The head slowly resumes its normal shape —a process completed, probably, in the course of two to three weeks.

Soon after birth the meconium is discharged from the intestines, and in a few days the evacuations assume a feculent character. The production of pepsin in the stomach, and the secretion by the pancreas of a fluid capable of emulsifying fats and digesting albuminoid substances, render the assimilation of milk practicable. The kidneys excrete an abundance of urine of a low specific gravity.

About the third day an exfoliation of the epithelium begins, which is maintained for a week, or even a longer period. During this time the hyperæmia of the skin is very marked, and imparts to it a red color, which as it fades passes into a yellowish tint. The breasts in both sexes swell very commonly, become red and sensitive, and yield upon pressure a serous, milky fluid.

Icterus of the new-born infant is a pretty common affection. Its occurrence is, however, largely influenced by local conditions. Thus, Porak placed the frequency at eighty per cent among the children born in the Hôpital Cochin in Paris; Kehrer, in the vast maternities of Vienna, at sixty-eight per cent; Ebstein, in Prague, at forty-two per cent; while West declares it is a rare phenomenon at the Rotunda Hospital in Dublin. It develops usually upon the second or third day, and ends, as a rule, by the sixth to eighth day. Kehrer * has shown statistically that it occurs more frequently in boys, in premature infants, in the children of primiparæ, and as a consequence of malpresentations. It is likewise promoted by atelectasis, by intestinal

* Kehrer, Studien über den Icterus Neonatorum, Jahrbuch f. Paediatrik, Bd. ii, p. 71, 1871.

affections, by depressing the temperature of the child, by insufficient feeding, and, in a word, by all the various pathological conditions and unfavorable hygienic influences intensifying or giving an abnormal direction to the ordinary changes which take place in the blood (Ebstein). Its frequency in lying-in hospitals is probably connected with a septic infection, for which the wounded surface at the navel furnishes the point of entry. It is rarely dependent upon gastro-duodenal catarrh, upon a narrowing of the bile-duct, or upon retention of meconium. The fæces are stained with bile. In all the tissues of the body, and most abundantly in the kidneys, pigment-crystals and yellowish-red amorphous granules are found deposited in greater or less quantities. It is as yet an unsettled question as to whether these pigment-bodies are the products of the liver or result from the disintegration of the blood-corpuscles. A very considerable destruction of the latter is found in all cases of icterus of the new-born. The tissue-waste is likewise marked. Hofmeier* found the average loss of weight in icteric children on the third day after birth was 9·3 per cent of the original weight, whereas in non-icteric children it was but 5·69 per cent. The urine contained an excess of urea and uric acid, and pigment-bodies proportioned to the intensity of the icterus. The pigment-bodies, he claims, furnished the characteristic color reaction with nitric acid of the acids of the bile. An expectant treatment is the only rational one. Laxatives are unnecessary, and perhaps harmful.†

Owing to the discharge of meconium and urine, and the limited amount of sustenance at its disposal, the new-born infant experiences a loss of weight in the first two or three days, estimated at from seven to eight ounces. After the second or third day the loss is gradually recovered, so that between the fifth and eighth days the weight at birth is reached. The loss of weight is greater in the children of primiparæ than in those of multiparæ, in artificially nourished infants, and where the immediate application of the ligature to the cord at birth has been resorted to.

The Management of the Puerperal State.

Sleep.—After every precaution has been taken against hæmorrhage, after the patient has been washed carefully and placed upon clean, dry bedding, and after the baby has been bathed and dressed, it is very desirable that the mother should enjoy a few hours of refreshing sleep. To this end the room should be darkened and absolute stillness enforced. The crying of the baby, the affectionate salutation of friends, or the tidying of the room by household Marthas, often becomes the

* Hofmeier, Die Gelbsucht der neugeborenen, Ztschr. für Geburtsh. und Gynæk., vol. vii, p. 287.

† Ebstein, Ueber die Gelbsucht bei neugeborenen Kindern, Volkmann's Samml. klin. Vortr., No. 189.

starting-point of nervous restlessness, which is with difficulty overcome by the aid of the strongest soporifics. Should the mother feel faint and exhausted, she should be allowed a cup of hot tea or bouillon.

In multiparæ it is well to leave with the nurse some form of anodyne, to be administered in case sleep is interrupted by the frequent recurrence and severity of the after-pains. Opiates, while they lull the pain, do not, after labor, arrest those physiological changes in the uterus with which the after-pains are associated.

Passing Urine.—As the natural impulse to urinate after delivery is very feeble, even when the bladder is full, the nurse should be instructed to solicit the patient to pass water in the course of eight or ten hours. It is usually recommended that the act of urination should be performed upon the back, which, of course, necessitates the use of the bed-pan. It has been my own rule to enforce the dorsal position during the first days of childbed, but there are a good many women who are able to pass water without difficulty in the sitting posture, who fail in the attempt when recumbent. Goodell therefore advocates the practice of raising the woman for purposes of urination from the beginning of childbed. He believes that the occasional assumption of the upright attitude for a brief period possesses the advantage of promoting drainage of the parturient canal, and of forestalling the evils incident to lochial stagnation in the vagina. The belief that such a course increases the risk of hæmorrhage he regards as unfounded. The physician should make it a rule to visit his patient within twelve hours from the time of confinement. He should then inquire not only whether she has passed water, but ascertain the quantity voided. If the quantity has not exceeded three to four ounces, he should introduce the catheter and make sure that the bladder is completely emptied. In cases of retention, the urine should be drawn at least four times in the twenty-four hours. Before using the catheter, the lochia should be carefully washed from the external parts with a warm carbolized fluid (two per cent), as the lochial discharge after the first day is liable to excite cystitis. Both the catheter and the operator's hand should be surgically clean. In passing the catheter beneath the bedclothes, the urethral orifice can readily be detected by first feeling for the tumefied urethra with the index-finger of the right hand through the anterior vaginal wall, and then following it in a forward direction until the meatus is reached.

Visits of the Physician.—The physician should see his patient at least once daily during the first week following confinement. During the first four days it is my custom to make both a morning and evening visit, not only for the purpose of noting carefully the pulse and temperature, but to be sure that my patient is not made a victim to traditional prejudices and superstitions. If the physician will take the

trouble to call occasionally upon his patient subsequent to the first week, to insure the unretarded progress of puerperal convalescence, he will do much to circumscribe the field of gynæcological practice.

General Directions.—Great care should be taken to keep the air of the lying-in chamber fresh and pure. If the room is warm, the patient should be lightly covered, owing to the tendency during childbed to profuse perspirations. There is no foundation for the prevalent belief that it is dangerous to comb the hair of a puerperal woman. Nothing contributes so much to the removal of soreness, and the healing of wounds in the genital canal, as cleanliness.

Where the antiseptic pad is employed this object is attained by thoroughly washing the external parts with a bichloride (1 : 5,000) or a carbolic solution (two per cent), whenever it becomes necessary to change the pad either by reason of the evacuation of the bowels or bladder, or because of the saturation of the pad with the lochial discharge. From the latter cause alone a change once in four hours in the early childbed period is to be advocated. The pad removed should be destroyed.

When the ordinary napkin is used external ablutions should be employed several times daily. It is a question whether the present tendency to prohibit the vaginal douche is warranted. Against its employment it may be urged, that in spite of the addition of carbolic acid or corrosive sublimate there is statistical evidence that the vaginal douche augments the chances of infection. In hospital practice it has invariably increased the morbidity and mortality rate. In my own private practice, on the other hand, it has proved to many patients a source of comfort. When carefully administered by nurses trained to aseptic work it has given rise to no injurious symptoms, and I still occasionally employ it—not, however, as a prophylactic, but because of the property possessed by hot vaginal injections to assuage pelvic discomfort.

Diet.—The diet should be selected with reference to the physiological requirements of the patient. Thus, during the first three days, when, as a rule, the patient is thirsty and is indifferent to solid food, the diet should consist of gruel, milk, milk-toast, and tea; to which may be added clear soups and bouillon, and soft-boiled eggs, should more stimulating aliments be called for. It is equally desirable, on the one hand, to avoid exciting colics and catarrhal affections of the stomach by too early resorting to a substantial regimen, and, on the other, to remember that the speedy establishment of an abundant milk secretion is apt to be hindered by subjecting women to a process of semi-starvation. After the bowels have moved on the third or fourth day, the normal appetite usually returns. All easily digested articles of food, such as eggs, chicken-broth, small birds, steak, chops, and the like, according to the taste of the patient, should then be allowed. Cooked

fruits are of service in overcoming the natural constipation of the puerperal period. The popular prejudice against fish and vegetables containing a large amount of nitrogenized substances seems to me well founded.

Laxatives.—The canonical practice of administering a laxative on the third day is of unquestionable utility. In most women there occurs an accumulation of fecal matter during the last weeks of pregnancy—an accumulation which is often enormous in quantity, and which creates a predisposition to puerperal affections. The remedies selected should, however, be adapted to the peculiarities of the individual. In some women an ordinary injection of soap and olive-oil in water suffices to procure an adequate evacuation; in others, the object is fulfilled by the milder laxatives, such as the compound rhubarb pill, a claret-glass of Hunyadi-János water, or the compound licorice powder of the German pharmacopœia; while in obstinate cases a calomel purge, or some such combination as the *post-partum* pill of the late Prof. Barker,* will be found requisite. Castor oil I give only in cases of severe colic, either alone or combined with fifteen drops of laudanum. In hæmorrhoids complicating puerperal convalescence, I can add my testimony to that already given by Prof. Barker as to the specific curative effect of half-grain doses of aloes administered night and morning.

Nursing.—Every healthy woman should nurse her child at least through the puerperal period.† The advisability of continuing lactation subsequent to the resumption of household duties must depend upon the question as to whether the mother is in a position to make the necessary sacrifices to the interests of the child. When the domestic and social demands upon her time and thoughts are numerous and pressing, lactation is apt to be imperfect, and the child will not thrive. Humanity, in such cases, requires that the child be surrendered to a wet-nurse. Nursing may be rendered impossible by a lack of milk, by flattened, misshapen nipples, and by the health of the mother. It should be prohibited in phthisis, in epilepsy, and in cases of syphilis contracted shortly before the birth of the child.

The child should be applied to the breast after the mother has rested, and within the first twelve hours following the end of labor. Soon after birth the child seizes the nipple eagerly, and though the quantity of nourishment obtained is small, it is infinitely better adapted to the child's needs than the catnip-teas and sweet oil which monthly

* Ext. colocynth. comp., ℈j; ext. hyoscyami, gr. xv.; pulv. aloes soc., gr. x.; ext. nuc. vom., gr. v.; podophyllin, ipecacuanha, āā. gr. j. M. Ft. pil. (argent.) No. xii. Of these, two usually act efficiently and without causing pain.

† The quantity of milk daily consumed by the infant during the first nine days increases, according to Deneke, gradually from one ounce and a half on the first day to about fourteen ounces on the ninth day. Ueber Ernährung des Säuglings, Arch. f. Gynaek., vol. xv, p. 340.

nurses employ as substitutes. The early application of the child to the breast benefits the mother by promoting the contractions and the involution of the uterus, and by lessening the painful distention of the breasts which occurs at the time when the function of lactation is fully established.

As the child sleeps for the most part during the first few days of existence, no rule can be laid down with regard to the frequency with which it should be placed to the breast. Afterward it should be accustomed to some regular routine. So long as the stomach is of small capacity and regurgitates a portion of its food, the interval should not exceed a couple of hours. From an early period, however, the child should be accustomed to sleep six hours at night, which gives an opportunity for the mother to recuperate her strength. This discipline is of course not practicable where the child sleeps in the same bed with the mother. After six months the child should not nurse oftener than five or six times in the twenty-four hours.

The breasts should be suckled in alternation. The nipples should be carefully washed both before and after nursing. The addition of boric acid to the water prevents the development of fungi. The extreme sensitiveness of the nipples at the commencement of lactation can be greatly relieved by applying constantly to them a rag wet with the *liquor plumbi subacetat.*, in the proportion of a teaspoonful to a tumbler of water. For a few days a metallic shield over the nipples, to prevent the rubbing of the night-dress or the bedclothes, is a source of comfort.

Duration of Lying-in Period.—Most women expect permission to be given them to sit up upon the tenth day. There should, however, be no fixed rule about leaving the bed which does not take into account the individuality of the specific case. Not to leave the bed before the tenth day is a safe rule in normal puerperal convalescence; but, where there are wounds to heal by granulation, a much longer period of time may be necessary. Garrigues* expressed his conviction that "the upright and sitting postures ought to be carefully avoided until involution has proceeded so far that the uterus has receded from the anterior wall of the abdomen and returned to the pelvic cavity"—a rule which would allow one woman to sit up in a week, while another would be kept in bed two weeks, or even longer. The continuance of the lochia rubra should serve as a warning against a change to the upright position. The first attempt at getting up should be tentative. The resumption of household duties should be postponed until the patient can walk about without fatigue or backache. When the abdominal walls are greatly relaxed, a well-fitted bandage should be worn for weeks subsequent to delivery.

* Garrigues, Rest after Delivery, Am. Jour. of Obstet., October, 1880, p. 861.

The Care of the New-born Infant.

As the new-born infant possesses feeble powers of resistance to cold, the first bath should be ninety-eight degrees, or nearly that of the body. The vernix caseosa should be softened by oil or fat-inunction, and gentleness employed in its removal. The child should then be gently dried in soft, warm cloths, and carefully examined with reference to any possible defect of formation or development. The cord should be wrapped in absorbent cotton,* and held in place upon the left side by a flannel bandage. After the cord has separated, the wounded surface should be dressed with iodoform, or bismuth powder.† The clothing of the child is the province of the nurse, and varies considerably in the different social ranks. Cleanliness and fresh air are essential to healthy development. To avoid sprue, the mouth of the child should be washed with cool water each time after nursing.

Selecting a Wet-Nurse.—Should the mother be unable to nurse her child, a wet-nurse should be urgently recommended. In selecting the latter, an examination should be made with regard to her constitution and health. The physician should, by inspecting the throat, the legs, the glands of the neck, and, if possible, the genital organs, exclude the existence of a syphilitic or strumous taint. A nurse should be between twenty and thirty-five years of age, and should present all the appearances of good health. The gums should be red and firm; the breasts should preferably possess a pyriform shape, and should be marbled with blue veins; it is not necessary that they should be large, but they should be firm, elastic, and nodular from abundance of glandular structure; the nipples should be well formed, prominent, and free from cracks and erosions; the milk should flow easily, and not be too bluish in color; the age of the milk should bear some correspondence to that of the child to be suckled. Aside from the question of adaptability, it is obvious that, where a great discrepancy exists, the milk of the nurse is liable to fail before the time of weaning is reached. One of the best tests of a nurse's capacity is the appearance of her own child. If the latter is plump, with well-rounded limbs, and with a healthy skin and mucous membranes, the presumptions are in her

* This plan, which I first saw recommended by Dr. W. D. Babcock, of Evansville, Indiana (Am. Jour. of Obstet., October, 1883, p. 1055), has since been warmly praised by Credé and Weber, Arch. f. Gynaek., vol. xxxiii, p. 73.

† Dr. Goodell seizes the cord, after it has been cut as usual, between the thumb and forefinger of the left hand, near the navel, and then strips off the gelatin of Wharton with the thumb and forefinger of the right hand. The pressure at the navel is next temporarily suspended where the internal portions of the vessels collapse. The cord is thereupon subjected to a second stripping, tied in the usual manner, and left free without any dressing whatever. The result is that it separates without any bad smell. (*Vide* Parry's note, Leishman's Midwifery, third American edition, p. 608.)

favor, even if she does not present in her own person, as Jacobi sportively suggests, a "combination of Aphrodite, Athene, and Psyche." When a choice has once been made, a change should not be recommended without a fair trial. It is by no means uncommon for a nurse but recently separated from her child, placed among strangers, and introduced to a foreign mode of life, to temporarily suffer from a diminution of the lacteal secretion, the milk returning in a brief period under the influence of kindness, habit, and a nourishing regimen. Moderate exercise is necessary for the maintenance of health. The nurse should be allowed to drink milk freely, but malt liquors should be prohibited, at least until toward the close of lactation.

Artificial Feeding.—If it is impossible to procure the services of a wet-nurse, or if the aversion of the parents to wet-nurses as a class proves unconquerable, artificial alimentation must be tried. It is unquestionable that many babies thrive fairly when brought up on the bottle. For success, scrupulous cleanliness, punctuality, intelligence, and experience are requisite. The beautiful roundness of outline, the *bien aise*, and the easy dentition of infants at the breast are, however, rarely attainable by those who are brought up by hand. Bottle-fed infants are apt to be lean, to be subject to attacks of indigestion, and to suffer from nervous disturbances when teething. If cow's milk is used as a substitute for human milk, the experiment is more likely to prove a success in the country, where the milk can be obtained fresh morning and evening, than in the city, where milk is of necessity at least twelve hours old at the time of delivery, and thirty-six hours old before a fresh supply can be obtained. My own experience inclines me to favor employing, where it is practicable, milk from one cow, especially if the cow is selected with reference to the child's individuality, precisely in the same manner as a wet-nurse would be selected. The fitness of the milk to the child is to be determined rather by experiment than by analysis. In a general way, however, it is well to remember that the milk of a very young cow is deficient in fat-globules, while that of an old cow is apt to err on the side of excessive richness, and that either extreme is equally liable to tax the infantile organs of digestion.

The difference in the digestibility of human and cow's milk is dependent upon a difference in the molecular arrangement of the casein varieties they respectively contain. The acid of the stomach precipitates human casein in the form of flocculent shreds, while that of the cow's milk is converted into firm, solid masses. Now, of the two forms it has been experimentally proved that the former is much more soluble in the gastric juice than the latter. With many physicians the favorite plan for neutralizing this objection consists in substituting cream for milk (diluted at first with three and afterward with two parts water [Biedert]), and thus to reduce the quantity of casein to

minimum proportions; but this diet, by confining the child almost entirely to the hydrocarbons, to the exclusion of the protein constituents, has never seemed to me in practice, even when well borne, to meet the full tissue requirements of a growing child. After many trials of this mixture, which found a warm advocate in the late Professor Childs, of this city, I have finally returned to milk of good standard quality, stirring it before using to distribute the fat-globules evenly between the different layers, and adding to it water proportioned to the age of the child, beginning with eight tablespoonfuls of milk to eight of water, increasing the one and diminishing the other a tablespoonful at a time as rapidly as the digestive organs exhibit a toleration of the change. The water does not, of course, alter the chemical constitution of the casein, but aids digestion by provoking an increased flow of the gastric juice, and incidentally contributes to alleviate thirst (Jacobi).

City milk should be boiled to prevent fermentation,* an unnecessary practice when milk can be obtained fresh night and morning. Instead of plain water, Jacobi has pointed out the utility of using some substance "which by its physical consistence is able to hold the casein-clots in suspension, thus protecting the stomach from irritation while they are being prepared for dissolution." I have been in the habit of following out to this end his earlier suggestion, to employ an indifferent substance, as gum-arabic or isinglass, for very young children, and afterward a thin decoction of oatmeal or barley, according to the tendency of the child to constipation or diarrhœa. The distress occasioned in some cases by the casein is often relieved by subjecting the milk to a peptonizing process.

Condensed milk is popular with many physicians, because children with whom it agrees fatten upon it, and suffer but little from indigestion and loose passages. The large amount of sugar it contains unfits it, however, for prolonged use. I have seen a number of children exclusively fed upon it, after passing through apparently a blooming infancy, develop symptoms of rickets at the end of their first year. I have, however, been in the habit of allowing its habitual use during the first three months of existence, and in the city during the hot months of summer.

Whatever the preparation selected, it should be warmed to blood-heat before it is given to the child. A small quantity of salt and a grain or two of bicarbonate of soda, or a tablespoonful of lime-water,

* This object is best attained by means of the steam sterilizer. The bottles in this apparatus, after being filled with milk, are immersed in boiling water until freed from micro-organisms. They are then hermetically sealed. The milk when thus treated will remain sweet for days. If the sterilization be complete, the milk will keep indefinitely. The perfection of the method immensely reduces the risks of bottle-feeding.

should be added to the infant's food, the former to promote assimilation, and the latter to neutralize any free acid the milk may chance to contain. When artificially reared, many children do not gain flesh, in spite of apparently healthy digestion. I have often derived great benefit, after the third month, from the addition to each bottle of a tablespoonful of Löfflund's Liebig's food for infants. Presumably the various forms of malt extracts now so popular in this country would serve the purpose equally well.

The bottle from which the child is fed should be scalded each time that it is used, and should then be filled with cold water to which a little soda has been added. The tube and mouth-piece should both be washed, cleaned with a brush, and allowed to soak in cold water in the intervals of feeding. Unless every precaution is taken to prevent the development of fungi, a bottle-fed infant will never prosper.

THE PATHOLOGY OF PREGNANCY.

CHAPTER XIV.

ACCIDENTAL COMPLICATIONS.—ABNORMITIES OF THE UTERUS.

Variola. — Rubeola. — Scarlatina.—Scarlatina puerperalis.—Cholera.—Typhus, typhoid, and relapsing fever.—Malarial fever.—Icterus.—Cardiac diseases.—Pneumonia.—Emphysema, chronic pleurisy, and empyema.—Phthisis.—Syphilis.—Chorea.—Surgical operations during pregnancy.—Double uterus.—Anteversion and anteflexion.—Retroversion.—Retroflexion.—Prolapse of uterus and vagina.—Hernias.

The pathology of pregnancy includes the various morbid conditions which exercise an unfavorable influence upon pregnancy, whether of maternal or fetal origin.

The maternal diseases comprehended under this title may consist of simple exaggerations of normal disturbances—a class which has, however, already received attention in connection with the chapter on the management of pregnancy; accidental complications which materially influence the circulation or the integrity of the pelvic organs; and, finally, diseases of the uterus and the uterine appendages which endanger the health of the ovum, or pave the way to its expulsion.

The pathological processes which affect the ovum may be primary, or may result secondarily from maternal disturbances.

The hæmorrhages of the first half of pregnancy and the premature expulsion of the ovum are ordinarily the result of fetal or maternal disease. Their consideration, therefore, forms a fitting conclusion to the subject-matter in hand.

The management of the hæmorrhages occurring in the second half of pregnancy requires a preliminary knowledge of the operative procedures of midwifery. Its consideration will therefore be postponed until the principles governing the conduct of difficult labor have undergone discussion.

Morbid states which exercise an unfavorable influence less during pregnancy than after the development of labor will, to avoid double mention, be considered in connection with the pathology of the latter process.

Accidental Complications of Pregnancy.

Variola attacks pregnant women more frequently than any other eruptive fever, and, although it manifests a preference for those in whom pregnancy is not far advanced, its type is severer and its prognosis graver when it affects women near their confinement.

Variola is, unless of a mild form, a peculiarly dangerous complication of pregnancy, greatly imperiling the life of both mother and fœtus,* through its tendency to metrorrhagia and abortion.

When the disease pursues its course without producing abortion, the child may present characteristic variolous cicatrices, or the latter may be absent. Occasionally the child remains unaffected by the disease until after birth, and may sometimes escape it altogether. During epidemics of variola, women may, without manifesting other symptoms of infection from the variolous poison, give birth to premature children, who remain unaffected with the disease. Children sometimes suffer from variola either before or soon after birth, while their mothers enjoy complete immunity from the disease.†

The healthy child of a mother affected with variola, or of one vaccinated during pregnancy, may be insusceptible to vaccinia for some time after birth.‡

It is advisable that all women becoming pregnant during an epidemic of variola should be immediately vaccinated.

Measles is an infrequent complication of pregnancy. In eleven cases collected by Klotz, nine were attended by premature delivery. This, according to Klotz,# is attributable not to excessive heat, nor to hæmorrhagic tendencies, but to an exanthematous form of endometritis.

Of the four cases occurring in his personal practice, all recovered. Of sixteen cases collected by Underhill,‖ in seven attacked during pregnancy there were two deaths; in seven cases in which the attack occurred at the end of pregnancy, two died; while in two cases attacked in childbed, both died. Aside from a disposition to puerperal hæmorrhage, pneumonia is a frequent and dangerous complication.

In measles, premature delivery is apt to be followed by chronic endometritis, which, in case of renewed pregnancy, becomes again a cause of abortion. The poison is sometimes transferred from the mother to the child during intrauterine existence.

* Meyer, Ueber Pocken, beim weiblichen Geschlecht, Berlin, Beitr. z. Geburtsh., ii, 1873, p. 197.

† Schroeder, Lehrbuch d. Geburtsh., p. 364.

‡ Spiegelberg, Geburtsh., p. 259; Max Runge, Die acute Infectionskrankheiten in ätiologische Beziehung zur Schwangerschaftsunterbrechung, Volkmann's Samml. klin. Vortr., No. 174, p. 1376.

Klotz, Beiträge zur Pathologie der Schwangerschaft, Arch. f. Gynæk., vol. xxix, p. 449.

‖ Underhill, Obstet. Jour. Great Britain and Ireland, 1880, p. 385.

Scarlatina is a less frequent complication of pregnancy than variola, attacks primiparæ by preference, although not exclusively, and manifests a decided tendency to develop itself in the puerperal state, even when infection has taken place in the earlier months of pregnancy. Olshausen * was able to collect from all the medical literature at his disposal only seven cases of scarlatina occurring during pregnancy, while the number of cases taking place in the puerperal state amounted to one hundred and thirty-four.

The theory that, in cases of exposure during pregnancy, the poison may remain dormant in the system, and after weeks or months of incubation may break out in childbed, is not inherently probable.†

The mortality of scarlatina occurring in pregnancy and in the puerperal state varies notably in different epidemics.‡ Attacks occurring immediately after confinement are more fatal than those developed later.

The stage of invasion may be entirely absent, or may exist for one or two days before the appearance of the eruption. When present, it is characterized by intense febrile movement, emesis, and notable congestion of the face. Usually, however, the earliest announcement of the attack consists in the sudden development of the eruption on all parts of the body. In severe cases the eruption soon assumes a characteristic livid color, which is usually retained until the fatal issue, should the latter occur within a week

The pharyngitis and tonsillitis and the tongue changes are either very mild or entirely absent. Diarrhœa is a frequent and dangerous complication. Albuminuria is common. Aside from the above-mentioned peculiarities, puerperal scarlatina presents no important variations from the clinical history of ordinary scarlet fever. The lochial discharge, the lacteal secretion, and the uterine involution are unaffected by the disease

Some authors have applied the designation "scarlatina puerperalis" to an infectious disease which, although resembling scarlatina, is still said to be identical with or closely related to puerperal fever. The theory advocated by them is based upon the fact that, in the cases upon which their deductions are founded, the angina was trivial in character; the attacks occurred usually within three days after confinement; infection with scarlatinus poison could not, in the majority of cases, be established; the rate of mortality was very high, and peri-

* Olshausen, Untersuch. über d. Complic. des Puerp. mit Scarlat. und die sogenannte S. puerperalis, Arch. f. Gynaek., ix, 1876, p. 169; Braxton Hicks, Trans. of the Obstet. Soc. of London, vol. xvii.

† *Vide* Boxall, Obstet. Trans. of London, vol. xxx; L. Meyer, Zeitschr. für Geb. und Gynaek., vol. xiv, p. 289.

‡ Denham saw only one recovery in eight and Hicks only four recoveries in eighteen cases: McClintock had ten fatal results in thirty-four cases; Boxall, sixteen cases with no deaths; L. Meyer, eighteen cases with one death.

tonitis and cellulitis were often revealed on autopsy. Olshausen * concludes with apparent justice, after a careful review of the reasons for and against the introduction of this new disease into obstetric nosology, that the grounds for its establishment are insufficient, and that the cases of so-called "scarlatina puerperalis" are nothing more than ordinary cases of scarlet fever modified by the concomitant puerperal condition, but in no way akin to puerperal pyæmia or septicæmia. It is worthy of note, that scarlatina and puerperal fever may occur in combination without mutually affecting their respective signs and symptoms. Braxton Hicks † advocates the extreme theory that a puerperal woman when infected with scarlatina develops puerperal fever, and that persons other than lying-in women contracting the disease through intercourse with the puerperal patients are attacked by scarlatina of the usual form.

Antipyretic measures, particularly cool baths, are indicated in proportion to the intensity of the febrile movement. Cathartics are to be avoided, because of the inherent tendency to diarrhœa, alluded to above. Special attention should be paid to the treatment of septic symptoms where these coexist.

Cholera.—The predisposition on the part of pregnant and puerperal women to cholera Asiatica is not usually decided, but varies with different epidemics, and is more marked in cities than in the country. Women are most liable to an attack of cholera in the latter half of pregnancy, particularly in the seventh and eighth months, and the prognosis is gravest for cases occurring at those periods. The prognosis is almost necessarily fatal in the case of children born before the ninth month.‡ The intensity of the disease is somewhat mitigated by the existence of the puerperal state. Slight attacks of cholera may take their natural course without prejudicial effects upon mother or fœtus, but the disease frequently results in abortion or premature delivery, due in part to hæmorrhagic metritis. The pathological uterine conditions observed in the cases recorded by Slavjansky # comprised roughening of the inner surface of the uterus by dark-violet shreds of the decidua vera, numerous extravasations permeating the mucous membrane, which remained intact in some places and was ulcerated at others, besides the presence in the uterine cavity of coagulated blood, pus, and shreds of the uterine mucous membrane.

The placenta fœtalis presented granular degeneration and almost complete disintegration of the epithelium covering the villi. Both of

* R. Olshausen, *loc. cit.*

† Braxton Hicks, Trans. of the Obstet. Soc. of London, 1871, pp. 44, 75.

‡ Ueber d. Einfluss d. C. auf Schw. u. Wochenbett, Monatsschr. f. Geburtsh., 1868, xxxii, p. 60.

Slavjansky, Endometrit. decidualis hæm. bei Cholerakranken, Arch. f. Gynæck., iv, 1872, p. 293.

the pathological processes above described conspire to induce the death of the fœtus, which then, in common with coagula and inflammatory products in the uterine cavity, acts as a foreign body and produces abortion. Schroeder * refers the death of the fœtus to asphyxia produced by changes in the maternal blood which interfere with the placental respiratory function. The clinical history of cholera is not materially affected by coexisting pregnancy, except in so far as uterine symptoms are concerned. Eclampsia sometimes occurs, and irregular uterine pains may persist for several days without producing abortion.† Cholera does not specially predispose to puerperal diseases, nor does it afford protection against them. Lactation, whether commencing or already established, is not markedly affected by cholera, although the lochia are often almost suppressed.

The treatment is conducted upon general principles. The artificial induction of premature delivery has had many advocates, on account of its supposed tendency to ameliorate the prognosis, but has now fallen into disrepute, although judicious measures to hasten parturition, already begun by nature, are regarded as justifiable.

Typhus, Typhoid, and Relapsing Fevers.—These fevers more frequently complicate the earlier than the later months of pregnancy, and affect the prognosis more seriously at the former epoch, owing to the greater tendency then existing to protracted *post-partum* hæmorrhage.‡ They may also, rarely, complicate the puerperal state.

Typhus fever manifests a less marked tendency to the induction of abortion or of premature delivery than either typhoid or relapsing fever, probably because it is less frequently accompanied by metrorrhagia.# It, however, occasionally produces these results, thereby essentially increasing the danger of a lethal termination.‖

Typhoid fever is frequently, and relapsing fever almost constantly, accompanied by abortion or by premature delivery induced by profuse uterine hæmorrhages,△ and thus greatly endanger life. The clinical history and the treatment of the fevers in question are unaffected by coexisting pregnancy except in so far as symptoms and indications having reference to the occurrence of metrorrhagia, abortion, or premature delivery, are concerned.

Malarial Fever.—Malarial fever is not a very frequent complication of pregnancy, perhaps because the latter secures a certain freedom from exposure to the malarial poison. Women who have previously experienced malarial fever, and who have been considered cured of the disease for several years, often suffer a relapse during subsequent preg-

* Schroeder, Lehrb. d. Geburtsh., 1872, p. 365. † Hennig, *loc. cit.*

‡ Wallichs, Monatsschr. f. Geburtsk., xxx, H. iv, 1867, p. 253; Spiegelberg, Handb. d. Geburtsh., p. 260.

Zuelzer, Monatsschr. f. Geburtsk., xxxi, H. vi, 1868, p. 419.

‖ Wallichs, *op. cit.*, p. 261. △ Zuelzer, *op. cit.*, p. 424.

nancies.* Attacks occurring under these circumstances may be regarded as acute exacerbations of a chronic malarial disease which has remained latent for a certain time. Malarial fever, according to Runge,† Ritter,‡ and most observers in this country, does not produce abortion except in rare instances, even when the febrile phenomena persist up to the termination of pregnancy; though Göth# has reported forty-six cases, in nineteen of which either abortion or premature delivery took place. Parturition usually suspends the periodic paroxysms, supposing them to have continued up to confinement, possibly owing to the loss of blood dependent on delivery, but the rule is not without exceptions. During the puerperal state, however, particularly in the second and third weeks, the paroxysms usually return, or a latent malarial cachexia may manifest itself in the manner previously alluded to.‖ The disease may be communicated to the fœtus, as has been proved by the detection of the characteristic pathological appearances induced by malarial poisoning in the spleen, and by the discovery of malarial pigment-granules in the blood and skin of children dying before or immediately after birth.^

Hubbard◊ reported an interesting case of intra-uterine malarial fever of the tertian type, in which the fetal movements were entirely suspended during the maternal paroxysms, and returned during the intermissions. The woman was confined during an intermission. On the following day the mother and child had a simultaneous paroxysm. Quinia was now administered, with the result of curing both mother and child—the latter obtaining the antiperiodic through the medium of the mother's milk.

The usual course of malarial fever is altered by coexisting pregnancy. Intermissions are usually wanting, and the fever becomes continued or remittent, the chills occurring irregularly.‡ Even those cases which most nearly approximate the usual malarial course show a tendency to anticipation or retardation of the paroxysms. The fever may assume a pernicious character, its tendency in this direction being accounted for by the nervous prostration and anæmia attendant upon the puerperal condition. Quinia best controls the febrile phenomena, but must be given in large doses, since the powers of digestion and of assimilation are seriously impaired by the puerperal state.‡

* Robert Barnes, Trans. of the Am. Gyn. Soc., 1876, p. 144.

† Max Runge, Volkmann's Samml. klin. Vortr., No. 174, p. 10.

‡ Ritter, Studien über Malaria-Infection, Virch. Arch., vol. xxxix, p. 14.

Göth, Ueber den Einfluss der Malaria-Infection auf Schwangerschaft, Geb. und Wochenbett, Ztschr. f. Gebh. und Gynæk., vol. vi, p. 17.

‖ Spiegelberg, Geburtsh., p. 261.

^ Max Runge, *loc. cit.*

◊ Hubbard, Edinburgh Med. Jour., June, 1866.

‡ Mendel, Intermittens während Schwangerschaft und Wochenbett, Monatsschr. f. Geburtsk., Bd. xxxii, H. i, p. 10.

‡ Barker, in a paper termed Puerperal Malarial Fever (Am. Jour. of Obstet.,

Icterus.—Icterus, although a phenomenon of rare occurrence during pregnancy, is interesting and important on account of its tendency to precede or to accompany the fatal pathological changes and symptomatic events connected with acute yellow atrophy of the liver. It is ordinarily assumed that this grave general disease is developed from a form of icterus which, when complicating pregnancy, usually has etiological relations identical with those of simple obstructive or so-called hepatic jaundice, although the causative condition frequently eludes observation. The development in pregnancy of icterus terminating fatally is also sometimes due to the lesions of phosphorus-poisoning. Davidson* attributes the fatal influence of pregnancy upon the course of simple icterus to the three following causes: 1. The impairment of the renal excretory function, due to the passive congestion produced by uterine pressure upon the renal veins. This etiological factor operates by causing the retention in the blood of the reabsorbed biliary acids, which, according to the investigations of Traube and others, are of themselves capable, even when present in the blood in moderate quantity, of producing acute yellow atrophy. 2. The hydræmia of pregnancy, which renders the system less capable of resistance to toxic agencies. 3. The impairment of cardiac activity, due to the retention of the biliary acids, which still further compromises renal eliminative action. Icterus often produces abortion by destroying the life of the fœtus. The causative connection between icterus and fetal death has been proved by the intense icterus of the dead fœtus, by the detection of biliary acids in its blood, and by the exclusion of other causes. After abortion a previously benign icterus may speedily develop all the characteristic lesions and symptoms of acute yellow atrophy.† Under these circumstances the sudden advent of the fatal symptoms may be accounted for by the anæmia and hydræmia induced by the hæmorrhage accompanying parturition. Assuming the correctness of the above-mentioned deductions with reference to the usual etiology of fatal icterus complicating pregnancy, we must admit the urgent indication in these cases for measures calculated to facilitate the elimination of the biliary acids from the blood by restoring the normal excretory function of the kidneys. An *early* resort to appropriate measures might, partially or entirely, prevent the accumulation of the poison upon whose presence such baneful results are believed to depend.

Cardiac Diseases.—The various effects produced upon pregnancy by coexisting heart-disease depend entirely upon the seat and character of the cardiac affection. While the results of myocarditis are serious,

April, 1880), furnishes a most valuable addition to our knowledge of the symptoms and treatment of this disease.

* Davidson, Monatsschr. f. Geburtsk., Bd. xxx, H. vi, 1867, p. 465.

† Schroeder, Lehrbuch der Geburtsh., p. 366.

because of its interference with the development of cardiac hypertrophy adequate for the compensation of existing valvular lesions, and acute endocarditis, occurring during pregnancy, shows a marked tendency to assume the fatal ulcerative form,* pericarditis has no perceptible effect upon the normal course of utero-gestation.† *Chronic* endocarditis often produces disastrous results, which may, in general terms, be accounted for by the fact that an amount of cardiac hypertrophy completely compensatory for pre-existing valvular lesions is no longer able to overcome the increased arterial and venous pressure prevailing during pregnancy, or to adapt itself to the sudden variations in vascular tension due to the parturient act. The augmented arterial pressure which calls for increased cardiac activity is referable, in part, to the newly developed utero-placental circulation. It is also attributed by some authors to the actual pressure of the gravid uterus upon the aorta; while Spiegelberg‡ believes it to be measurably due to the plethora of pregnancy, and to the limitation of the intra-thoracic space by the encroachments of the diaphragm. An important source of varying and perturbed heart-action is, moreover, found during labor in the suddenly changing conditions of pressure produced by the alternating uterine contractions and relaxations with the corresponding violent respiratory efforts.

Spiegelberg* refers the symptoms of aortic insufficiency or stenosis, which are usually most marked in the later months of pregnancy, solely to cardiac disturbances due to increased arterial tension, and the disappearance of these symptoms after birth to the restitution of the normal pressure. McDonald‖ refers the improvement not so much to the diminution of the arterial tension as to the absence of the extra tension associated with the bearing-down effort. Spiegelberg considers the grave symptoms of mitral disease often presenting themselves soon after confinement as referable to excessive distention of the right heart with blood forced into it from the contracted uterus. Fritsch△ opposes this view, and attributes the morbid phenomena of mitral disease to the accumulation of blood in the abdominal vessels recently released from the pressure of the gravid uterus, and to the cardiac paralysis resulting from an insufficient blood-supply and consequent defective nutrition of the heart.

The hydræmia of the puerperal state may contribute to the impair-

* Lebert, Beitr. zur Casuistik der Herz- und Gefässkrankheiten im Puerperium. Arch. f. Gynaek., Bd. iii, 1872, p. 39.

† Porak, De l'infl. récip. de la grossesse et des mal. de cœur, 1880, p. 92.

‡ Spiegelberg, Ueber d. Comp. des Puerp. m. chron. Herzkr., Arch. f. Gynaek., ii, 1871, p. 236.

* Spiegelberg, ibid., p. 233.

‖ McDonald, Heart Disease during Pregnancy, Parturition, and Childbed, p. 47.

△ Fritsch, Die Gefahren d. Mitralisfehler, ibid., viii, 1875, p. 381.

ment of nutrition, and thus co-operate with the above causative agencies in the production of cardiac paralysis.

Fresh inflammatory affections may attack the valves and endocardium of a heart already weakened by disease. This occurs by preference in cardiac cases of more recent origin. In all cases of heart disease, and especially in those with acute symptoms, there is great danger of embolism. Slight exposure to cold and exertion in pregnant patients with cardiac diseases is liable to occasion pulmonary disturbances. These appear usually in the second half of pregnancy.*

The symptoms of aortic valvular disease are usually manifested during the latter half of pregnancy. They consist in palpitations, dyspnœa, and, in extreme cases, in abortion or premature delivery. Should pregnancy proceed to a normal termination, the symptoms are aggravated by parturition, and syncope is of common occurrence, but the symptoms disappear speedily after labor is ended. Mitral valvular lesions, if slight or completely compensated for, may not manifest their existence by any rational symptoms. If, however, the compensation be inadequate, the patient's life may be greatly and sometimes suddenly endangered by the occurrence, either before or after confinement, of extreme pulmonary congestion and œdema, ascites, albuminuria, or metrorrhagia. The fœtus may die *in utero*, as the result of metrorrhagia or of impaired nutrition due to deficient oxygenation of the maternal blood. Children whose mothers are the victims of cardiac disease are often imperfectly developed, and predisposed to untimely death. The prognosis is based upon the general conditions of the patient. In seventeen of the thirty-one cases collected by McDonald the patients died. The prognosis is impaired by coexisting pulmonary lesions, tending to obstruct the circulation in the lungs, as well as by diseases of other vital organs. Mitral lesions are of more grave significance than those at the aortic orifice, and mitral stenosis is particularly dangerous,† because of its tendency to produce dilatation of the left auricle and the heart.

Women with cardiac disease of any considerable gravity should be dissuaded from marriage. The indications for medicinal treatment are the same as for cardiac diseases uncomplicated by pregnancy. Chloroform should be administered with special caution during parturition. McDonald, however, believes that, cautiously administered in the second stage, chloroform is useful by diminishing the down-bearing efforts. In order to lessen the latter, the same author urges as of extreme importance the timely application of the forceps, or the performance of version in suitable cases, should the second stage be in any way prolonged. The artificial induction of abortion or of premature delivery is justified only, according to McDonald, in cases where, as in hydramnion, the abdomen is unduly distended.

* McDonald, *l. c.*, pp. 199, 200. † Porak, *op. cit.*, p. 113; Fritsch, *op. cit.*, p. 383.

Acute Lobar Pneumonia.—Pneumonia attacks women less frequently than men. Its rate of mortality is, however, much larger among the former. These facts should be remembered by investigators of the reciprocal relations between pneumonia and pregnancy, in order that the influence exerted by the former upon the latter be not exaggerated. Pneumonia is an infrequent complication of the pregnant state, but affects the course of the latter very prejudicially.* Although a pneumonia of large extent may terminate in complete recovery without having endangered the life of mother or fœtus,† it often produces abortion or premature delivery, the frequency of these results increasing in direct proportion to the duration of pregnancy. The type of the pulmonary inflammation is also more severe in the later stages of utero-gestation, and parturition exerts an unfavorable effect upon women in proportion as their pregnancy is far advanced.‡

It was formerly believed that pneumonia, occurring during pregnancy, owed its fatal character chiefly to the encroachments of the gravid uterus upon the intra-thoracic space, and to the consequent interference with the necessary compensatory increase of functional activity on the part of the healthy lung-tissue. Later investigations having not only shown the fallacy of this theory,# but even rendered probable an actual increase in the intra-thoracic space during pregnancy,‖ the fatal character of intercurrent pneumonia is referred to coexisting hydræmia, and to the inability of the poorly nourished heart to restore the balance of a pulmonary circulation disturbed by the consolidation of lung-tissue and by the consequent impermeability of large capillary areas. Pulmonary œdema, resulting from progressive cardiac asthenia, directly induces the fatal issue. Parturition itself, whether naturally or artificially produced, greatly imperils the woman's life^ by making exorbitant demands upon the already failing heart-power and by aggravating existing hydræmia. Abortion, when occurring under these circumstances, is referred to fetal death caused by deficient oxygenation of the maternal blood, by placental anæmia produced through an inadequate supply of blood to the left heart, and by the abnormally elevated maternal temperature.◊ From the fatal results of parturition in pneumonia we conclude that the induction of abortion or of premature delivery in ordinary cases is unjustifiable.‡ Should labor, however, have already begun, its termination must be hastened by all available means. Our further treatment must

* Fasbender, Ueber P. als Schwangersch. Complicat., etc., Beiträg. z. Geburtsh., iii, 1874, Sitzgsber., p. 54.

† Gusserow, Pn. b. Schwangeren, Monatsschr. f. Geburtsk., xxxii, H. ii, 1868, p. 93.

‡ Wernich, Beiträg. z. Geburtsh., iii, 1874, Sitzgsb., p. 56.

Gusserow, *op. cit.*, p. 88.

‖ Wernich, Berlin. Beiträg. z. Geburtsh., ii, 1873, p. 249.

^ Fasbender, *op. cit.*, p. 55. ◊ Spiegelberg, Lehrb. d. Geburtsh., p. 265.

‡ Wernich, *op. cit.*, p. 261.

consist in efforts at strengthening the heart's action. Brandy and carbonate of ammonia, digitalis and quinia, deserve the most confidence for the fulfillment of these indications. Wernich recommends cautious venesection for the relief of extreme dyspnœa or cyanosis, and proposes that the collapse to which bloodletting may lead be combated by transfusion.*

Emphysema, Chronic Pleurisy, and Empyema.—These affections are dangerous complications of pregnancy, in that they produce cardiac dilatation and prevent the heart from successfully adapting its activity to the varying conditions of vascular tension obtaining in parturition and the puerperal state. The induction of abortion or of premature delivery may be indicated by the existence of these diseases, provided the mother's strength has become so impaired as to incapacitate her for continued utero-gestation.

Phthisis.—It was formerly erroneously held that pregnancy afforded immunity against *pulmonary phthisis*. This view may have been based upon the clinical fact that the progress of pre-existent phthisis is sometimes retarded by the supervention of pregnancy.† This result is observed, according to Lebert,‡ in only a small proportion of cases. In the majority of instances, pregnancy not only hastens the progress of actually existing phthisis but precipitates its development. The latter result is of especially frequent occurrence in those hereditarily predisposed to the disease, or in such persons as may have recovered from a previous attack. These effects of pregnancy upon the development and course of phthisis are most manifest between the ages of twenty and thirty years, although they are not infrequent between the ages of thirty and forty. The advanced stages of phthisis prevent conception, but the same is not true of its earlier periods. The puerperal state often favors the development of phthisis, particularly in those hereditarily predisposed to it, and usually hastens the fatal issue of the disease if it has already manifested itself. In very exceptional instances, however, parturition and the *post-partum* state exert a favorable influence upon the course of phthisis. It often happens that women with inherited tendencies to phthisis may escape it during their first pregnancy, only to become its victims in a later one.# Although women with progressing phthisis may pass through the parturient and puerperal states in safety, they are greatly prostrated thereby, and rarely have sufficient milk to nurse their children. They, moreover, often experience abortion or premature delivery. The children of such women are usually puny and feeble. They are slowly and im-

* Schroeder, Lehrb. d. Geburtsh., p. 364.

† Wernich, Berlin. Beiträg. z. Geb., ii, 1873. p. 251.

‡ Lebert, Ueber Tab. d. weiblich. Geschlechtsorgane, Arch. f. Gynaek., iv, 1872, p. 469.

Spiegelberg, Lehrb. d. Geburtsh., p. 266.

perfectly developed, and are predisposed to pulmonary disease. Prophylactic treatment affords the only encouraging prospects of success in the cases under consideration. Girls with suspected hereditary predisposition to phthisis should, accordingly, not marry, as they should not become mothers. If they do bear children, they must never nurse them.

Syphilis.—When syphilis, which is a frequent complication of pregnancy, is contracted at the beginning or during the course of the latter, it is characterized by intense initial and by unusually mild consecutive symptoms.* The duration of the incubation is ordinarily about two weeks, but may be protracted to six weeks. The initial lesions, which are more extensive than in women who are not pregnant, may involve the vagina, cervix, labia, nates, and thighs. They embrace swelling, reddening, and excoriation of the mucous membrane and skin, œdema, eczema, follicular abscesses, and even necrosis of connective tissue. These intense inflammatory processes may be referred to increased nutrition of the parts, and to the mechanical results of friction between them. The secondary symptoms are of a mild type, consisting chiefly of general glandular induration, papules on and around the genitals, and scales on the palms and soles. Mewis † states that the occurrence of parturition has a favorable effect upon these lesions, usually resulting in their disappearance. Erythema, pharyngitis, alopecia, iritis, and febrile movement are either absent or slightly marked. Pregnant women owe the mildness of their secondary symptoms to amelioration of their general nutrition. Syphilis exerts a very prejudicial influence upon the product of conception. If either parent be affected with general syphilis at the time of the coition resulting in impregnation, syphilis is communicated to the fœtus. It is almost equally impossible for a fœtus poisoned by the paternal reproductive element to infect a healthy mother. Provided the mother were untainted at the time of conception, syphilis contracted by her during pregnancy is rarely communicated to the fœtus. If the father be syphilitic, the infection of the ovum is accomplished by the diseased spermatozoids. If the mother be constitutionally tainted, the ovum is already poisoned. Should both parents be the victims of general syphilis, each equally bequeaths the disease to the offspring. It is probable, too, that the syphilitic poison can traverse the septa intervening between the fetal and the maternal vascular systems.‡

A progressive and continuous diminution in the intensity of fetal

* Sigmund, Ueber d. Verlauf. d. S. bei Schwangerschaft, Wien. med. Presse, xiv, 1873, No. 1.

† Mewis, Syphilis congenita, Ztschr. f. Geburtsh. u. Gynaek., iv, 1879, I, p. 62.

‡ Professor McLane, of this city, has reported to me the history of a well-observed case, where error was hardly possible, in which the mother, previously healthy, was infected in the fourth month, and gave birth in the ninth month to a dead child with well-marked syphilitic lesions.

syphilis, directly proportionate to the length of time which has elapsed since the contraction of the disease by the parent who communicated it, is observed in cases unmodified by treatment. Parents whose syphilis is allowed to pursue its natural course retain the capability of transmitting the disease to their offspring for varying periods, the average length of which is ten years. Latency of the parental syphilis does not secure immunity of the fœtus from the disease, although it diminishes the probability of its transmission. Parents with tertiary syphilitic symptoms may or may not communicate the disease to their children, according as the poison whose original presence produced the gummata is still retained in the system or has been eliminated by nature or by mercurials. In accordance with the varying intensity of the hereditary influence, the fœtus may either perish *in utero*, its death resulting in abortion or premature delivery, may be born alive but destined to die early, or may manifest the disease only at the expiration of periods varying from weeks to months. Conception occurring during the first years after the parents' infection with syphilis almost invariably terminates in abortion or premature delivery, the causes of which are either the vitiated nutritive processes of the fœtus, the increased maternal temperature due to syphilitic fever, or syphilitic degeneration of the fetal placenta, consisting, according to Mewis,* of inflammatory changes in the tunica intima of the blood-vessels. Similar pathological changes are said, by the same author, to occur in the intima of the umbilical vessels. The pathological conditions observed in syphilitic disease of the placenta are either granular degeneration of the placental villi, with obliteration of the blood-vessels, or the morbid changes designated by the names endometritis placentaris gummosa and endometritis decidualis.† (For a more detailed account of placental syphilis, *vide* chapter on placental diseases.)

Every pregnant woman who at the time of conception is or has been affected with constitutional syphilis, should be promptly subjected to a thorough mercurial treatment, preferably by the method of inunction. This is desirable even when no present symptoms are detected, with reference to the prevention of the frequently disastrous influences of latent syphilis. If, however, the disease be contracted during the later months of pregnancy, the treatment may consist of palliative measures until after parturition, since no harm will result from the maternal syphilis to the fetal life. Local primary or secondary disease of the genitals should receive appropriate treatment, in order that the child be not infected during delivery.

Chronic Nephritis.—There are few subjects about which so much confusion of thought exists as that of albuminuria in pregnancy. With most it is associated in the mind with eclampsia, and yet

* Mewis, *loc. cit.*, p. 42. † Fränkel, *op. cit.*, p. 52.

eclampsia in chronic nephritis is a comparatively rare event. (1:40 according to Fehling's statistics; 2:70 according to those of Seyfert).

It is desirable to differentiate, therefore, the various conditions in which albuminuria develops during pregnancy. Fehling's* researches in this direction have a special value.

In the transitory form in which eclampsia is most apt to occur, the albuminuria develops in the later months of pregnancy. It is associated with an abundance of hyaline and granular casts, and has a tendency to disappear after labor. There is, moreover, no especial disposition for the albuminuria to return in later pregnancies.

In a second group, women who in the non-pregnant state are apparently healthy, or who exhibit only slight traces of albumen in the urine, develop albuminuria from the beginning of pregnancy. In these cases the casts in the urine are scanty, the heart's action is increased in force, there is sometimes œdema, and occasionally the condition is associated with hæmorrhages. In most cases death of the fœtus occurs in consequence of placental changes. The amniotic fluid diminishes in quantity, the uterus is arrested in its development, and the albuminuria disappears in part, or in its entirety. Characteristic of this form is its tendency to recur with each consecutive pregnancy.

In still another group of cases the albuminuria is due to chronic interstitial or parenchymatous nephritis. With pregnancy there is usually an acute exacerbation of the symptoms. Casts and albumen become more abundant, œdema develops, albuminuric retinitis is a common complication, and nasal or intracranial hæmorrhage may occur.

The causes of the increased trouble are attributed to reflex contraction of the arterioles and consecutive anæmia of the unaffected portions of the kidney, and to associated venous congestion resulting from cardiac insufficiency. As regards treatment, Fehling advises to examine the urine frequently, especially if œdema is present. Slight traces should admonish to watchfulness. If the amount of urine exceeds one per cent, woolen underwear should be worn; the action of the skin should be maintained by tepid baths; the diet should consist in large measure of milk, and alcohol should be avoided. In severer cases rest in bed, hot baths (98° to 107°), and warm packs often give relief.

If, however, there are headache, nose-bleed, heart disturbance, or if no improvement in the number of casts or in quantity of albumen results from treatment, abortion or premature labor is indicated.

In chronic nephritis, death of the child from placental changes (white infarctions, according to Fehling) is so common that considerations for the life of the child must be always subsidiary to the interests of the mother.

* Fehling, Weitere Beiträge zur klinischen Bedeutung der Nephritis in der Schwangerschaft, Arch. f. Gynaek., vol., xxxix, p. 468.

In chronic nephritis it is not desirable that the kidneys should be subjected to the hazards of a renewal of pregnancy.

Diabetes in Pregnancy.—Dr. Mathews Duncan * has called attention to the very serious consequences of diabetes complicating pregnancy and the puerperal state. But few cases have been recorded. Diabetes may occur during pregnancy, and in some cases during pregnancy only. It may cease after the termination of pregnancy, and may not return in pregnancy after its cure. Pregnancy may occur during diabetes, and in that case may be apparently unaffected in its healthy progress by the disease.

In twenty-two pregnancies, occurring in fifteen mothers, four terminated fatally. In several, death was by collapse rather than by coma. Hydramnios was frequent, and in one case sugar was found in the fluid.

In seven out of nineteen pregnancies, occurring in fifteen mothers, the child died in pregnancy, having in all of them reached a viable age. In two more the child was feeble at birth, and died a few hours after. In one case the child was diabetic.

With one exception, all the mothers were multiparæ.

Chorea in Pregnancy.—Chorea, which is a rare complication of pregnancy, affects primiparæ by preference, particularly those possessing an hereditary predisposition. Barnes † was able to collect only fifty-six and Fehling ‡ only twelve additional cases from the whole domain of obstetrical literature.

Organic cerebral lesions are assumed by Spiegelberg # as established causes of the disease. In regard to other etiological agencies wide diversities of opinion prevail. According to Goodell, ‖ the choreic movements are of reflex nature, and are referable to impaired nutrition of the central nervous system, incident to the hydræmia of pregnancy. The association of chorea and organic cardiac disease has been frequently observed, and the discovery in certain cases of fibrous vegetations upon the mitral and aortic valves accounts for the assumption by some authors of embolism as a cause of chorea. Barnes △ discountenances this view, and calls attention to the probable causative agency of myelitis. Terror and other intense emotions may act as exciting causes of chorea.

Choreic movements occurring in pregnancy do not differ from those attending the disease in the unimpregnated state. They are usually bilateral. In most cases the muscular contractions manifest themselves in the earlier months of pregnancy, and continue until

* Matthews Duncan, On Puerperal Diabetes, Obstet. Trans., vol. xxiv, p. 256.

† Barnes, Trans. of the Obstet. Soc. of London, x, 1869, p. 147.

‡ Fehling, Arch. f. Gynaek., vi, 1874, p. 137.

Spiegelberg, Lehrb., p. 255.

‖ Goodell, Am. Jour. of Obstet., May, 1870, p. 149.

△ Barnes, *loc. cit.*, p. 179.

delivery is accomplished. In rare instances they are arrested at the beginning of parturition. In still more exceptional cases the contractions may either cease before delivery or persist during the *post-partum* state. Transitory albuminuria and diabetes mellitus are occasional unexplained complications of chorea gravidarum, and the phosphates and urates of the urine are present in abnormal abundance. Abortion and premature delivery, due to the repeated succussion of the uterus, are of very frequent occurrence.

Chorea exerts a prejudicial influence upon the course of pregnancy,* having interrupted it in about one half the recorded cases. Death of the mother resulted in seventeen of the fifty-six cases collected by Barnes.† The lethal termination was usually referable to the exhaustion consequent upon protracted muscular exertion, or to hemiplegia secondary to grave cerebral or spinal lesions. The life of the child is less frequently sacrificed, but it is itself often affected with chorea.

The treatment consists in the administration of iron and quinine, and the lowering of the reflex excitability by the prolonged use of the bromide of potassium. During the attack, chloroform, chloral, and the subcutaneous injection of morphia are often serviceable. When palliative remedies prove fruitless, in view of the perilous nature of the affection, artificial labor or even abortion is indicated.

Relaxation of the Pelvic Symphyses.‡—This condition, which consists in an excess of the ordinary physiological softening at the pelvic articulations, may permit of such a degree of mobility between the pelvic bones as to effectually hinder locomotion. This is usually accompanied by pains in the ligaments of the joints affected, in the thighs, and in the lumbar region. Its existence is easily recognized. Thus, motion at the symphysis pubis becomes apparent if, with the patient in an upright position, she be made to throw the weight of the body upon each leg in alternation, while the accoucheur holds the symphysis between the thumb and two fingers placed within the vagina. Motion in the sacro-iliac joint is perceived by seizing the crests of the ilium and getting the patient to move forward. In the recumbent posture movements at either the pubic or sacro-iliac joints may be recognized by means of the vaginal touch, upon extending or flexing the femur.

The great relief afforded to all the symptoms in such cases by means of a firm binder makes it most desirable that the possibility of its occurrence should be always borne in mind where the patient walks with difficulty during the latter months of pregnancy, or subsequent to the

* Goodell, Am. Jour. of Obstet., vol. viii, p. 168.

† Barnes, Trans. of the Obstet. Soc. of London, x, 1869.

‡ Snelling, On Relaxation of the Female Pelvic Symphyses, American Journal of Obstetrics, February, 1870; Barker, Puerperal Diseases, p. 192.

childbed period. The first case I witnessed at the Bellevue Hospital was altogether a mystery to me, until the nature of the disability was pointed out by Professor Barker. The patient was in the last month of pregnancy, had been six weeks in bed, unable to move, though apparently otherwise in perfect health. A rude bandage, constructed of canvas and made to lace in front, furnished a good support, and enabled my patient to stand and move around without inconvenience. She had, at the end of gestation, a good confinement, and subsequently recovered without a trace of her previous difficulty.

In childbed a towel-binder is capable of rendering good service. During pregnancy, or during the period of puerperal convalescence, where frequent changes of the bandage are not necessary, Martin's girdle, consisting of a solid metal ring surrounding the whole pelvis, has been strongly recommended. I employ a pair of strong breeches, furnished me by Philip Schmidt, instrument-maker, of this city, which are carefully fitted to the thighs and hips of the patient, and are made to buckle in front and lace behind. The apparatus is light, comfortable, and answers every requirement.

Surgical Operations during Pregnancy.—Massot* concludes, from the observation of a considerable number of cases, that ordinary *surgical operations* do not interfere with pregnancy unless they materially and permanently disturb the uterine circulation, or call into activity the uterine muscular force by reflex irritation. Cohnstein† states as the result of his researches, that after operations and injuries pregnancy reaches a normal termination in 54·5 per cent of all cases. Interruption of pregnancy was in his cases determined—(*a*) by the period of pregnancy when the operation took place, occurring more frequently as the result of surgical measures resorted to in the third, fourth, and eighth months; (*b*) upon the seat of the operation, resulting, in two thirds of all cases, from operations upon the genito-urinary organs; (*c*) upon the extent of the wound following amputations, exarticulations, and ovariotomies with great relative frequency; (*d*) upon the number of children, occurring in multiple pregnancy with uniform regularity. Age seemed to exert no causative influence. Abortion directly results under these circumstances from reflex irritation, or from fetal death referable to hæmorrhage or to septic poisoning on the mother's part. The prognosis, so far as the mother is concerned, depends upon the time when delivery occurs. The mortality ordinarily attending delivery, if at term, is insignificant; for abortions and premature deliveries it amounts, according to Cohnstein, to thirty-three

* Massot, Ueber d. Einfluss traumat. Einwirk. auf d. Verlauf der Schwangerschaft, Schmidt's Jahrb., 1874, 164, p. 266.

† Cohnstein, Ueber chirurg. Op. bei Schwangeren, Volkmann's Samml. klin. Vortr., No. 59, 1873, p. 493.

per cent. The most frequent causes of the mother's death are shock, peritonitis, septicæmia, hæmorrhage, and œdema pulmonalis. In ninety cases of minor operations upon the pelvic organs collected by Professor Mann,* of Buffalo, there were twenty abortions and four deaths. They included the removal of a caruncle, of epitheliomata, of condylomata, and of polypi, the opening of cysts and abscesses, the dilatation of the urethra for stone, the plastic operations upon the vulva, cervix, and vagina, etc. He concludes that during pregnancy the union of denuded surfaces is the rule, that the most risky operations are those upon the rectum, and that vaginal operations are apt to be attended by severe hæmorrhage, though not otherwise dangerous. In view of the manifest danger from operations of any magnitude, it may be stated as a general law that surgical measures not absolutely indicated by the existence of pathological conditions liable to aggravation by delayed interference should be postponed until after confinement. Those morbid conditions, however, whose development is hastened by pregnancy, which threaten the existence of pregnancy, or whose existence offers mechanical obstacles to parturition, must be early subjected to operative interference. This remark applies with special force to carcinomatous growths in any part of the body and to intrapelvic tumors.

The time of operation should not coincide with the menstrual epoch of pregnant women, as abortion is more likely to occur at that period.† For a similar reason it is recommended that the third, fourth, and eighth months should be avoided. Massot is of the opinion ‡ that anæsthetics, when employed during operations on pregnant women, exert rather a favorable than a prejudicial effect upon fetal life by diminishing reflex irritation.

Abnormal Conditions of the Uterus.

Double Uterus.—Double uterus occurs under various forms. The uterus and cervix may be double, the vagina remaining single. The double uterus may have a single cervix opening into an undivided vagina. The uterus, although double, may have a single cervix opening into a double vagina, the septum beginning at the os internum; or uterus, cervix, and vagina may be double throughout.

All these forms permit of normal utero-gestation on either side or on both sides simultaneously, provided that each half of the genital canal be sufficiently developed. If, however, the dividing septum extends quite to the vaginal entrance, simultaneous pregnancy in each horn is exceedingly rare.#

* Mann, Surgical Operations on the Pelvic Organs of Pregnant Women, Gynæcological Trans., 1883.

† Spiegelberg, Lehrbuch d. Geburtsh., p. 268.

‡ Massot, *loc. cit.*, p. 267. # Schroeder, Lehrb. d. Geburtsh., p. 376.

If pregnancy occur in only one side of a double uterus, a decidua vera is developed in the other side, and expelled at the end of pregnancy. Double uterus is less readily diagnosticated during pregnancy than after or before it, but is usually recognized with facility. A double vagina is not necessarily indicative of double uterus, but if two vaginæ are found, each containing a cervix, the presence of double uterus may be safely assumed. If a double cervix terminate in an undivided vagina, the uterus may or may not be double. When pregnancy exists in only one horn the uterine development is manifestly unilateral, and the existence of an unimpregnated half may be determined by combined manipulation or by the uterine sound. In cases presenting a double uterus with a single cervix and vagina, the diagnosis rests chiefly upon unilateral uterine development and depression of the fundus and body corresponding to the septum. The form of a double uterus is most plainly manifest during the contractions accompanying and succeeding parturition.* It is still undecided whether double uterus be a cause of abortion and of premature delivery. Ordinarily, however, the symptoms and course of pregnancy are unaffected by this malformation. The complete functional independence of the two segments is demonstrated by the fact that in twin pregnancies parturition is frequently not simultaneously accomplished by them. In the case of unilateral pregnancy, the ratio of head to breech presentations is, according to Schatz, as twenty-one to two. Tedious labor may result in cases of double uterus from uterine atony, referable either to imperfect muscular development of the pregnant horn, to its deviation from the normal pelvic axis, or to obstruction produced by the unimpregnated horn. *Post-partum* hæmorrhage may result from uterine atony or from attachment of the placenta to the septum, whose imperfect development prevents its firm and thorough contraction.

Anteversion and Anteflexion.—The normal anteversion of the unimpregnated uterus is exaggerated by the increased weight of the gravid uterine body, but this deviation is usually rectified by the gradual development and upward movement of the uterus. In exceptional cases the anteversion persists after the fourth month, and produces vesical tenesmus, dysuria, or incontinence. No evidences of uterine incarceration are, however, observed, and the comparatively trivial symptoms are relieved by regulating defecation, replacing the fundus, causing the patient to assume the dorsal decubitus, or by adjusting an appropriate pessary.

In the later stages of utero-gestation anteversion combined with anteflexion may again occur, and produce the deformity known as pendulous abdomen. It is then chiefly due to the inadequate sup-

* Schatz, Mitth. aus d. Leipz. Geb.-Klinik u. Polyklinik, Arch. f. Gynaek., ii, 1871, p. 297.

port afforded to the uterus by the abdominal parietes. The failure of their sustaining power is referable to their relaxation—which is most marked in multiparæ—to separation of the recti muscles, or to the yielding of old cicatrices produced by operations or injuries. The displacement is also favored by lordosis of the lumbar vertebræ and by contracted pelvis, which prevent the normal descent of the uterus. In extreme cases of pendulous abdomen, the uterus, having separated the recti, descends, covered by fascia and skin, almost or quite to the knees, and seriously interferes with locomotion. Its pressure also produces œdema of the abdominal wall, vesical tenesmus, and pain in the distended cutaneous tissues. These symptoms are relieved by reposition of the uterus and by the application of a suitable abdominal bandage.

Retroversion.—Retroversion, a comparatively infrequent form of displacement in the unimpregnated uterus, usually rectifies itself during the earlier months of pregnancy. Should spontaneous restitution not occur, the fundus being detained below the promontory until after the third month, the cervix bends upon itself at an acute angle, and the retroversion is transformed into a retroflexion.

Retroflexion.—Retroflexion occurs infrequently in women who have not borne children, but often renders sterile those who are thus affected. It is one of the most common uterine displacements in women who have borne children, though it does not in their case, ordinarily prevent conception. When conception occurs in a retroflexed uterus, the latter usually rises from the pelvis, and assumes a position of anteversion at the fourth month. In many cases, however, the displacement produces congestion of the uterine mucous membrane, metritis, and abortion. In still other cases the fundus does not ascend above the promontory at the usual time, and either the symptoms of retroflexion with incarceration are slowly developed, or that form of retroflexion known as partial retroflexion, or retroflexion in the second half of pregnancy, occurs. This consists in the division of the uterine cavity into an anterior and a posterior diverticulum or pouch. The anterior diverticulum is produced by the more rapid upward development of the anterior uterine wall, which is subjected to comparatively slight pressure and contains the larger part of the fœtus. The posterior uterine wall enters predominantly into the formation of the posterior diverticulum, and usually contains the fetal head. This peculiar form of uterine displacement may be spontaneously rectified during pregnancy, or may persist until delivery, producing no important symptoms except vesical and rectal tenesmus, with dysuria and painful defecation. In the latter case it materially interferes with parturition, inasmuch as the cervix, which is displaced upward and forward behind the symphysis, is not situated in the pelvic axis, and the posterior diverticulum is forced by the uterine contractions against

the perinæum and posterior vaginal wall. Even at this stage Nature may restore the uterus to its normal position; but, in default of spontaneous restitution, it must be replaced by forcing up the posterior diverticulum with the hand introduced into the rectum, while the anterior pouch is displaced downward by pressure upon the abdomen and by traction applied to the cervix; or, where version is practicable, by bringing down the breech, room may be made for the release of the imprisoned head.

Retroflexion of the Gravid Uterus, with Incarceration.—Although this form of retroflexion is usually developed in the gradual manner above described, it may, in rare instances, be rapidly produced by sudden abdominal compression or concussion.

The symptoms, which are in either case essentially the same, differ chiefly in the varying rapidity of their development, and result from the pressure of the displaced uterus upon the intrapelvic viscera and tissues. They embrace dysuria, eventuating sometimes in complete retention of urine from urethral compression, vesical tenesmus, incontinence of urine, painful defecation, constipation or obstipation, violent sacral and lumbar pains which radiate into the thighs, and in grave cases emesis, with all the other symptoms of ileus Abortion, followed by spontaneous restitution and recovery, may occur even at this stage. Should incarceration, however, persist, violent metritis, parametritis, and peritonitis may lead to a fatal issue. In rare cases, gangrene of the uterus or vagina may be induced. A lethal termination may also indirectly result from pathological processes in the bladder occasioned by retained and decomposing urine. These morbid processes consist in cystitis, sometimes complicated by diphtheritic and gangrenous inflammation of the mucous membrane and of the deeper vesical tissues, which may lead to septicæmia or to rupture of the bladder. Death may, moreover, result from passive renal congestion and uræmia.

The diagnosis of uterine retroflexion with incarceration is based upon the foregoing clinical history; the fluctuating abdominal tumor, from which large quantities of urine may be obtained by the catheter or by puncture; the œdema of the vulva; the presence in Douglas's *cul-de-sac* of a tumor presenting the characteristic consistence of uterine tissue; the position of the cervix and meatus urinarius behind the symphysis; and the distention of the perinæum by the fundus uteri.

The distinction between an incarcerated uterus and an extra-uterine pregnancy is sometimes difficult, necessitating a thorough bimanual examination, aided, in cases of abdominal tenderness, by the employment of an anæsthetic.

The replacement of the uterus, which, of course, is the objective point of treatment, should in all cases be preceded by the evacuation of the bladder. This is usually accomplished without much trouble

by means of a sharply curved male catheter, and by remembering that the urethra is ordinarily deflected somewhat to one side. Cohnstein states that the introduction of the catheter is facilitated by seizing the posterior lip or the vaginal portion with volsella forceps, and diminishing the pressure on the urethra by tractions made in a backward direction. Veit,* in an experience of from seventy to eighty cases, found catheterization always practicable. Where intelligent effort is attended by failure, puncture is allowable. To this end an aspirator needle—which, however, should not be of too small caliber—should be passed through the abdominal walls at a point about three inches above the symphysis. In practice this operation has thus far proved devoid of danger, though the possible risk from infiltration of urine should act as a check to its rash employment.

After emptying the bladder spontaneous reposition may take place. If this does not speedily occur, the patient should be put in the knee-elbow position, and steady pressure should be made with two or four fingers upon the fundus, through the vagina. With a little patience this method rarely fails. E. Martin † reports sixteen cases, in four of which spontaneous reposition followed the evacuation of the bladder, and in eleven reposition was accomplished in the knee-elbow position. In my own practice the latter method has so far invariably proved successful. If anæsthesia is required, the replacement of the uterus should be attempted with the patient in the Sims latero-prone position. Pressure upon the fundus should be exerted by four fingers introduced into the vagina or rectum. Barnes ‡ recommends tilting the fundus to one side, so as to disengage it from the projection of the promontory. It may happen that the first attempt may be only partially successful, while a renewal of the manipulation after twelve to twenty-four hours may lead to complete reduction (Veit).

In exceptional cases the replacement of the uterus may be prevented by inflammatory adhesions, or by the secondary swelling of the displaced organ. The induction of abortion then becomes imperative, either by the ordinary methods or by puncture of the uterine walls.

The introduction of a uterine sound or a flexible catheter is rarely practicable. In a case reported by P. Müller,* where the retroversion was complete, with the fundus upon the perinæum and the cervix looking directly upward, Müller resorted to the following ingenious expedient: He cut off the end of a male silver catheter, and then bent the extremity into a hook. Having succeeded in passing the latter

* Veit, Ueber die Retroflexion der Gebärmutter in den späteren Schwangerschaftsmonaten, Volkmann's Samml. klin. Vortr., No. 170, p. 1363.

† E. Martin, Rückwärtsneigung der schwangeren Gebärmutter, Ztschr. f. Geburtsh. und Frauenkrankheiten, vol. i, p. 1.

‡ Barnes, Obstetric Operations, third American edition, p. 276.

* P. Müller, Zur Therapie der Retroversio Uteri gravidi, Beitr. zur Geburtsh., Bd. iii, p. 67.

into the cervix, he introduced a piece of catgut through the tube between the membranes and the uterus. After twelve hours, during which the catgut was left *in situ*, the fœtus was expelled. If catheterization can not be accomplished by either of the foregoing methods, puncture of the uterus with a fine trocar, and with antiseptic precautions, has proved a tolerably safe procedure, and, by the withdrawal of a portion of the amniotic fluid, a certain means of provoking abortion.

Prolapse of the Pregnant Uterus.—In rare instances the normal pregnant uterus becomes prolapsed during the early months through mechanical violence, and its sudden displacement may lead to abortion through uterine congestion and hæmorrhage. Ordinarily, however, procidentia uteri is only observed during pregnancy when it has antedated conception, and it is most frequent in multiparæ. A slight prolapse disappears temporarily with the ascent of the uterus. A well-marked procidentia, however, as a result of which a part or the whole of the uterus has been extruded from the vagina, is often attended by symptoms of incarceration terminating in abortion. There is no recorded instance of procidentia in which pregnancy persisted until the time of normal delivery in a uterus lying wholly without the vagina. Procidentia uteri is simulated by hypertrophy either of the supravaginal or of the infravaginal portion of the cervix. This pathological condition is unattended by grave results, unless it lead to rigidity of the os uteri, tedious delivery, and uterine inertia. If excessively developed, however, the portio vaginalis may be transformed into a pulpy, polyp-like mass, which by its constant friction and irritation produces abortion. It should not be mistaken for prolapse of the uterus, as efforts at reposition may produce irritation sufficiently severe to induce premature delivery. Amputation of the hypertrophied cervix performed during the third month does not necessarily disturb pregnancy, and is indicated in aggravated cases, because of the possible prejudicial influence of cervical hypertrophy, unmodified by treatment, upon utero-gestation and parturition.

When prolapse, even of slight extent, exists in a pregnant uterus, the normal ascent of the organ should be encouraged by the avoidance of exertion and by careful regulation of defecation and micturition. In more pronounced cases the uterus must be replaced, and sustained by a suitable tampon Spiegelberg * advises the use of a cotton tampon soaked in glycerin and held in position by a perineal bandage, and renewed at short intervals. Caution is necessary in the reduction of the uterus, lest the fundus be caught beneath the symphysis and the procidentia converted into a retroflexion. When incarceration has occurred and the parts are much swollen, their volume may be reduced by scarification, after which reposition must be attempted. Should it

* Spiegelberg, Geburtshülfe, p. 278.

fail, abortion should be induced before the incarceration has irreparably compromised the vitality of the pelvic tissues.

Prolapse of the Vagina.—A slight degree of vaginal prolapse occurs more frequently in pregnant women than does uterine prolapse. Cases of more complete prolapse of the vagina are, however, almost invariably attended with procidentia uteri. The anterior vaginal wall is usually alone involved in the prolapse, although the posterior wall may descend alone, or both walls become simultaneously prolapsed. This displacement produces traction upon the bladder and rectum, resulting in irritation of these organs and of the vulva. During parturition, moreover, the prolapsed vagina offers an impediment to delivery, and may therefore be subjected to an amount of pressure incompatible with the maintenance of its vitality. The treatment consists in producing regular alvine evacuations, and in sustaining the vagina with cotton tampons and a perineal band, or with the latter alone. During labor, persistent efforts at reposition of the prolapsed vagina must be made between the pains. Should these attempts prove effectual, the vagina must be sustained in proper position until the descent of the head has occurred. If reposition be impossible, the forceps must be resorted to in order to prevent the disastrous results of excessive pressure on the vaginal tissues, and traction must be so applied as to avoid injury of the anterior vaginal wall.

Hernias of the Pregnant Uterus.—Although hernias of the unimpregnated uterus are very rare, they still occur much more frequently than those of the gravid uterus. The most frequent forms under which they present themselves are the umbilical and the ventral. Femoral and inguinal uterine hernias, as well as hernias through the foramen ovale and the great sacro-sciatic foramen, also occur. The sac of a ventral hernia is often formed by the yielding and dilatation of extensive cicatrices in the abdominal wall, such as result from ovariotomies and gastrotomies, or by the separation of the recti muscles.

Femoral and inguinal uterine hernias are either congenital or are produced by ovarian or omental hernias, between which and the uterus adhesions exist. Pregnancy has been observed to occur most frequently in inguinal uterine hernias, next in umbilical, and least frequently in femoral hernias.* It has never been discovered in a uterus which had escaped through the foramen ovale or the greater sacro-sciatic foramen. Pregnancy occurring in inguinal or femoral uterine hernias is uniformly terminated by abortion or by premature delivery. The diagnosis is readily made if due regard be paid to the absence of the uterus from its natural situation, to the shape and consistence of the hernial tumor, to the physical signs furnished by auscultation and percussion over it, and to the displacement of the vagina toward the site of the hernia.

* Spiegelberg, Geburtsh., p. 280.

When the hernia is recognized at an early date, the uterus must, if possible, be restored to its normal position, and there retained by an appropriate truss. Should attempts at reposition be unsuccessful, artificial abortion should be induced, as it will otherwise occur spontaneously at a later date, and under less favorable conditions. When the product of conception has already attained a large size, reposition and delivery, whether spontaneous or artificial, are rarely accomplished unless the constricting hernial ring be previously divided. Even the latter procedure may prove ineffectual, in which case hysterotomy is the last resort.

CHAPTER XV.

DISEASES OF THE DECIDUA.—DISEASES OF THE OVUM.

Endometritis decidua: 1. Chronica; 2. Tuberosa; 3. Catarrhalis.—Anomalies of the placenta.—Anomalies of form; of position; of development; of circulation.—Placentitis.—Degenerations.—Syphilis.—Anomalies of the amnion and of the amniotic fluid.—Hydramnion.—Deficiency of amniotic fluid.—Anomalies of the umbilical cord: torsion; knots; hernias; coiling of the cord; cysts; stenoses of vessels; marginal implantations.—Hydatidiform mole.

Endometritis decidua.—The normal congestion of the uterine mucous membrane attendant upon conception, and resulting in the formation of the decidua, may, under the irritating influence of various exciting causes, develop into endometritis. The inflammation may be either acute in character, as is often the case in cholera Asiatica and other infectious diseases,* or may pursue a chronic course, presenting itself in the three distinct forms about to be considered:

I. Endometritis decidua chronica diffusa.—The causes of this form of endometritis are not usually readily discoverable. It is believed to be sometimes developed from an endometritis antedating conception. It is also referred to syphilitic infection,† to excessive physical exertion,‡ and to secondary inflammation resulting from the death of the fœtus and its retention in the uterine cavity.#

The anatomical changes characteristic of this form of endometritis consist essentially in thickening and induration of the decidua, due to a more or less diffuse development of new connective tissue, and to proliferation of the decidual cells. Cysts have been observed in the hypertrophied decidua by Hegar and Maier.‖ Kaschewarowa dis-

* Slavjanksy, Arch. f. Gynaek., iv, p. 285.
† Fränkel, Arch. f. Gynaek., v, 1873, p. 53.
‡ Kaschewarowa, Virchow's Arch., 1868, vol. xliv, p. 113.
# Schroeder, Geburtsh., sixth edition, p. 392.
‖ Spiegelberg, Geburtsh., p. 301.

covered newly developed and hypertrophied involuntary muscular fibers in the substance of the decidua.* Extravasations into the hypertrophied decidual tissue are of frequent occurrence.† The decidua vera or the decidua reflexa may be separately or jointly involved in these pathological processes, and may be affected throughout a part or the whole of their extent. When the hyperplasia of the mucous membrane is developed in the later months of utero-gestation, pursues a notably chronic course, is limited in extent, or does not involve the placental decidua, pregnancy may proceed to a normal termination. When, however, the endometritis appears early, assumes an acute or hæmorrhagic type, is attended by partial separation of the decidua, or involves the placental decidua, it frequently induces abortion or premature delivery, either by causing the death of the fœtus through interference with its nutrition‡ or by exciting reflex uterine contractions. Parturition may, in either case, be protracted by the slow separation of the decidua, between which and the deeper uterine tissues adhesions have been formed by the newly developed connective tissue and muscular fibers. If the placental decidua be involved in the morbid process, the placenta may be separated with difficulty, and its slow expulsion be attended by copious hæmorrhages. Another consequence of the hyperplasia of the decidua in the later months of pregnancy, according to Kaltenbach,# consists in the non-separation of the decidua vera at the time of parturition. The thickened membrane is either rapidly detached after childbirth, forming a sac to which blood coagula adhere, and which in turn become the occasion of hæmorrhage, or it is slowly eliminated, giving rise to a putrid discharge, and furnishing materials for auto-infection. He advises, therefore, in cases of syphilis in either parent, that a careful examination be made of the membranes at childbirth, and, if no traces of the decidua are to be found upon their surface, to introduce the hand into the uterus, and to remove retained portions; or, should this not be done, to promote their expulsion by ergotin, and to employ prophylactic antiseptic injections.

II. Endometritis decidua tuberosa et polyposa.—The etiology of this variety of decidual inflammation is involved in obscurity. Syphilis was regarded as a causative agent by Virchow, who first described the degenerative changes under consideration,‖ and pre-existent endometritis is also supposed to occupy a causative relation to them. Gusserow△ suggests that conception occurring soon after delivery may

* Kaschewarowa, *loc. cit.*, p. 111.

† Eigenbrod und Hegar, Monatsschr. f. Geburtsk., vol. xxii, 1863, p. 161.

‡ Klebs, Monatsschr. f. Geburtsk., 1866, vol. xxvii, p. 402.

Kaltenbach, Diffuse Hyperplasie der Decidua am Ende der Gravidität, Zeitschr. für Geburtsh. und Gynæk., vol. ii, p. 225.

‖ Ahlfeld, Arch. f. Gynæk., vol. x, 1876, p. 173.

△ Gusserow, Monatsschr. f. Gynæk., vol. xxvii, 1866, p. 323.

excite the recently formed vascular uterine mucous membrane to abnormal proliferative processes. It is doubtful whether the latter are ever secondary to irritation produced by the death of the fœtus.* In Ahlfeld's cases the inflammation was apparently idiopathic.

The pathological processes peculiar to this variety of endometritis are usually observed in the decidua vera alone, and manifest a preference for those portions of the decidua corresponding to the anterior and posterior uterine surfaces. In some cases, characterized by absence of the decidua vera, the decidua reflexa is found involved in the morbid changes. The latter consist in marked thickening of the entire decidua referable to proliferation of the interstitial connective tissue and to extensive hypertrophy of the decidual cells, which are provided with nuclei of enormous size. Occasional free nuclei occur.† The uterine surface of the decidua is rough and covered with coagulated blood, while the entire mucous membrane is exceedingly vascular. Upon that surface of the decidua which is directed toward the ovum are situated large excrescences or elevations, the prevailing shape of which is polypoid. They may, however, appear in the form of nodules, of cones, or of boss-like projections provided with a broad, non-pedunculated base. Their height is from one quarter to one half an inch, and their surface is smooth, very vascular, and devoid of uterine follicles. The latter are, however, plainly visible on the mucous membrane intervening between the polypoid outgrowths, but they are compressed and their orifices constricted or obliterated by the pressure of whitish, contracting bands of newly developed connective tissue. Similar fibrous bands surround the blood-vessels. On section, the larger prominences sometimes appear permeated with coagulated blood, and narrow, cord-like bands of hypertrophied decidual tissue occasionally form bridge-like connections between neighboring polypi. The uterine follicles are in some cases filled with blood-clots. The epithelium is often absent from the uterine surface of the decidua except around the orifices of the follicular glands,‡ and the deeper decidual tissues contain large numbers of lymphoid cells. The cells of the decidua reflexa frequently undergo fatty degeneration. The placental villi may show hypertrophy of their club-shaped ends, or be the seat of myxomatous growths, in which case their cells are granular and cloudy. The fœtus is generally dead and partially disintegrated. This form of endometritis decidua is consequently usually accompanied by abortion, which occurs predominantly at an early stage of pregnancy.

III. Endometritis decidua catarrhalis.—Hydrorrhœa gravidarum.—This form of uterine inflammation is less intense than the two varie-

* Schroeder, Geburtsh., sixth edition, p. 393.

† Gusserow, *loc. cit.*, p. 322.

‡ Hegar, Monatsschr. f. Geburtsk., vol. xxii, 1863, pp. 300, 429.

ties just described, affects pluriparæ more frequently than primiparæ, and seems to stand in etiological relations with hydræmia. The pathological processes involved in the disease are vascularity, hyperæmia, and hypertrophy of the interstitial connective tissue and of the glandular elements of the decidua. The inflammation involves the decidua vera by preference, but may simultaneously affect the decidua reflexa. The most striking symptomatic occurrence is due to the glandular hypertrophy, and consists in the escape from the uterine cavity of a thin, watery, muco-purulent or sero-sanguinolent liquid, which resembles the amniotic fluid both in color and in odor. Provided that free exit be afforded to the secretion, its discharge is affected gradually and in small quantities. Should, however, obstacles to its continuous evacuation be encountered, either in the usual adhesions between the decidua vera and reflexa or in impenetrability of the os internum, the secretion, having accumulated between the decidua and the chorion, forces a passage through the decidua reflexa and is discharged in considerable quantities. In some cases even a pound or more of the liquid is thus suddenly evacuated. Small quantities of the secretion are often observed as early as the third month. The more abundant discharges occur only in the later periods of pregnancy, and are often attended by slight uterine contractions, which may, in exceptional cases, become so severe as to induce abortion or premature delivery.

The diagnosis involves differentiations between a discharge emanating from the hypertrophied decidual glands and the *ante-partum* escape of a fluid which sometimes accumulates between the amnion and chorion. The latter discharge, the quantity of which may be so large as to stimulate hydramnion, differs from that of hydrorrhœa gravidarum in that it occurs only once.* The escape of the decidual secretion might be mistaken for that of the amniotic fluid, which may be easily distinguished by the fact that the latter immediately precedes delivery. The treatment should embrace analeptic and tonic measures, as well as the careful avoidance of vaginal douches and of all local irritation tending to produce abortion. Should uterine contractions accompany the escape of the decidual fluid, appropriate anodyne treatment must be adopted.

Anomalies of the Placenta.

1. **Anomalies of Form.**—The usually round or oval placenta may be of a horseshoe or other irregular shape. The superficies depends upon the extent to which the villi form vascular connections with the decidua. In general terms it may be stated that the thickness of the placenta is in inverse proportion to its surface extension. Placentæ

* Spiegelberg, *op. cit.*, p. 303.

succenturiatæ, small accessory placental developments, are due to the persistence of isolated villous groups, which form vascular connections with the decidua vera. Placentæ spuriæ consist of circumscribed developments of villi, the decidua not participating in the growth. A placenta membranacea is a broad and thin vascular membrane produced by a diffuse proliferation of the villi over the entire ovum, forming vascular connections with the reflexa, or, where the latter is absent, with the vera.

2. **Anomalies of Position.**—The placenta may be attached over the os internum, thus constituting placenta prævia, over the orifice of the Fallopian tube, or in connection with extra-uterine pregnancy, at various points in the abdominal cavity.

3. **Anomalies of Development.**—A hypertrophied placenta is abnormally large in proportion to the size of the fœtus, occurs chiefly in connection with hydramnion, and consists of a genuine parenchymatous hyperplasia. A small placenta is referable either to defective development, to premature involution, or to hyperplasia of the connective tissue, with subsequent contraction.*

4. **Anomalies of Circulation.**—Hæmorrhage into the placenta is sometimes produced by congestion of the utero-placental vessels, due to disturbances in the mother's vascular system.† The extravasation may, rarely, be intraplacental, may occur into the serotina, thus constituting utero-placental apoplexy, or may take place into the uterine sinuses. In the last case, thrombosis of the placental sinuses is said to have occurred.‡ Placental hæmatomata are the above-mentioned collections of coagulated blood in various stages of disintegration. The causes of the hæmorrhage are chiefly morbid changes in the decidual vessels, often referable to placentitis. The extravasated blood usually experiences the ordinary retrogressive metamorphoses. It sometimes undergoes cystic, fatty, or calcareous degeneration. The pressure upon the villi produced by the hæmatomata impairs the nutrition of the fœtus, and may cause the death of the latter.

Œdema of the placenta, a morbid condition usually attributed to derangement of the fetal or umbilical circulation, is characterized by abnormal pallor, with increased size, friability, and succulence of the placenta, due to serous infiltration. The morbid anatomical changes consist essentially in cystic dilatation in and between the villi, accompanied sometimes by extravasations.

5. **White Infarctions of the Placenta.**—This term is applied to thickenings of the placental tissue, varying in color from a yellowish red or yellow to a dirty or grayish white. They have a dense structure, are moderately firm in young infarctions, with more of a fibrous

* Whitaker, Am. Jour. of Obstet., August, 1870, p. 229.

† Nouv. Dict. de Méd. et de Chirurg. Prat., vol. xxviii, Placenta, p. 63.

‡ Slavjansky, Arch. f. Gynaek., v., 1873, p. 360.

character in older ones. In size they vary from that of a bean to that of an English walnut. For the most part they are sharply circumscribed; sometimes flattened, sometimes oval or rounded or wedge-shaped. In some cases the infarctions send out radiate processes. More frequently they are found upon the maternal surface of the placenta. They do, however, form on the fetal side. They may extend through from surface to surface, or may be imbedded in the placental substance.

These so-called infarctions apparently are due primarily to a hyaline degeneration of the decidua. The same process extends to the decidual vessels, and thence to the intervillous spaces. In these a coagulation of the blood takes place. The ensuing compression exerted upon the fetal villi leads to their necrosis and obliteration.* Fehling believes that rupture of the maternal vessels due to endarteritis may likewise serve as the primary cause of the compression and necrosis of the villi.

White infarctions are present in nearly every placenta. When few in number and of small size, they are innocuous. In syphilis, in endometritis, in nephritis (Fehling), etc., they may lead to extensive destruction of placental tissue, and are the most frequent cause of the intra-uterine death of the fœtus.

6. **Degenerative Changes.**—(*a*) Fatty degeneration of the placenta, circumscribed or diffused, may result from retrograde changes in extravasations. When developed early in pregnancy, it is sometimes regarded as a premature completion of the fatty degeneration normally occurring at the end of pregnancy, and may be due to syphilis or scrofula. (*b*) Amorphous calcareous deposits are frequent, and are almost invariably found on the uterine placental surface, in the decidua serotina. Thence the process may extend to the fetal portion of the placenta. When the calcareous change begins in the fetal tissues it is confined to these, and affects the small blood-vessels of the villi, beginning in their terminal ramifications and gradually involving their trunks. (*c*) Pigment deposits, resulting usually from alterations in the hæmoglobin of extravasations, are found in both healthy and diseased placentæ within the blood-sinuses or villi. (*d*) Cysts are of frequent occurrence in the placenta. They are found near the center of its concave surface, and vary from a few lines to several inches in diameter. The cyst-wall is covered by the protruding surface of the amnion. The fluid in the cysts contains albumen and mucin. Fenomenow † regards these cysts as the product of the placental villi. The latter, he supposes, in consequence of irritative changes, swell and undergo a partial

* For *résumé* of literature of the subject with recent observations, *vide* Jacobsohn, Untersuchungen über die Weissen Infarcte der Placenta, Ztschr. für Geb. und Gynæk., vol. xx, p. 237.

† Fenomenow, Zur Pathologie der Placenta, Arch. f. Gynæk., vol. xv, p. 343.

loss of epithelium. The denuded surfaces adhere, and thus spaces are formed. The fluid he regards as an excessive physiological secretion from that portion of the epithelium which remains intact upon the villi.

7. **Syphilis of the Placenta.**—In placental syphilis the placenta is pale and heavy, often equaling one third of the weight of the fœtus. It only exists, according to Fränkel,* in connection with congenital or hereditary fetal syphilis. It involves the maternal portion of the placenta, when the mother was infected either before or soon after conception, and produces gummatous proliferation of the decidua, characterized by the development of large-celled connective tissue, with occasional accumulations of younger cells.

When the infection is conveyed by the father to the fœtus alone, or to both mother and fœtus, pathological changes occur as the result of a chronic inflammatory process, embracing proliferation of the cells and connective tissue in the villi, with subsequent obliteration of the vessels, often complicated by the marked proliferation and hardening of their epithelial covering.

The affected villi become swollen, cloudy, and thickened, while their epithelium undergoes proliferation and cloudy swelling. The parenchyma of the villi is filled with lymph-cells, and the vessels are either compressed or obliterated. The blood-sinuses are gradually encroached upon by the villi, the fœtus dies from lack of adequate nutrition, and the villi undergo fatty degeneration. Portions of the healthy placental tissue, which often intervene between the diseased parts, may be the seat of extravasations.

Anomalies of the Amnion and of the Amniotic Fluid.

I. **Hydramnion.**—Inasmuch as the amount of the liquor amnii varies considerably within normal limits, the term hydramnion should be restricted to those cases in which the amount of fluid is so large as to produce morbid symptoms by its pressure upon the uterus, the abdominal and thoracic viscera. When the quantity exceeds two to three pints, inconveniences are often experienced. It is, however, usually only when the higher degrees—viz., five pints and upward—are reached that the symptoms possess such an intensity as to constitute a special malady.

It is customary to distinguish an acute and a chronic form—in the former a rapid increase in the size of the abdomen taking place in a few days, or even, as in a case reported by Sentex, in a single night; whereas in the latter the progress is slow, extending over months, and occasioning infinitely less disturbance of function.

Etiology.—The causes of hydramnion are hardly to be found in a

* Fränkel, Arch. f. Gynaek., v, 1873, p. 52.

single morbid condition. In a limited number of cases—and this is especially true of the rare acute form, though even in these not in all reported instances—the excessive production of fluid was found to be associated with inflammation of the amnion. In by far the largest proportion of cases, however, the evidence is strong that the excess of fluid is of fetal origin. Sallinger's * experiments show that when a liquid is injected into the umbilical vein it transudes with great rapidity into the amniotic sac, and that the amount of transudation is proportioned to the pressure exerted, and to the size of the cord. Jungbluth described, during the first half of pregnancy, a capillary network (*vasa propria*), connected with the vessels of the umbilical cord, developed just beneath the amnion, in that portion of the chorion which covers the placenta. Levison † found that this capillary network was persistent at term in hydramnion, but not in normal pregnancy. Between these vessels and the inner surface of the amnion, canalicular spaces furnished a series of communicating passages. Lebedjew ‡ concluded that in certain abnormal conditions of the fœtus found associated with hydramnion the capillary network of Jungbluth was persistent to the end of pregnancy. With these anatomical conditions an increased secretion, due to stasis in the *vasa propria*, would result from any condition causing stenosis of the umbilical vein, from obstructions to the hepatic circulation, and from diseases of the fetal heart and lungs. In this connection it is proper to observe that syphilis, and especially syphilitic affections of the liver, are frequently associated with hydramnion.

Charpentier found that, in one hundred and twenty-three cases of multiple pregnancy, fifty-two were cases of hydramnion. Küstner,# Schatz,‖ and Werth ^ have recently drawn attention to the occurrence of hydramnion affecting one amniotic sac only in twins developed from the same ovum—i. e., with a single chorion, the sac of the second fœtus containing less than the normal quantity of fluid. In all these cases, in the fœtus contained in the hydramniotic sac both heart and kidneys were hypertrophied, and the amniotic fluid contained an unusual amount of urea. The cardiac hypertrophy Küstner ascribes to the appropriation by the stronger fœtus of the placental territory, which in twin pregnancies from a single ovum is primarily common to both fœtuses. The increased work thus entailed upon the heart leads to a thickening of its walls, which in turn is followed by increased growth and activity of the kidneys. In Küstner's cases there was likewise

* Sallinger, Dissert. Inaugural, Zürich, 1875.

† Levison, Summary in Arch. f. Gynæk., vol. ix, p. 517.

‡ Lebedjew, *vide* Traité pratique des accouchements, par Dr. A. Charpentier. p. 886.

Küstner, Arch. f. Gynæk., vol. xxi, p. 1.

‖ Schatz, Arch. f. Gynæk., vol. xix, p. 329.

^ Werth, Arch. f. Gynæk., vol. xx, p. 353.

hepatic obstruction. Werth suggests that the activity of the fetal circulation leads to more active absorption on the part of the placental villi, and that the insufficient action of the kidneys, in their attempt to maintain the necessary equilibrium in the fetal circulation, explains the outpouring of fluid not only into the amnion but into the serous cavities of the fœtus, as is often observed in hydramnion.

The question as to how far the amniotic fluid may be of maternal origin is still an undecided one. Ahlfeld and Leopold maintain that serum may pass through the pores in the chorion and amnion from the vessels of the decidua reflexa (and later from those of the ova) directly into the amnion. Zuntz, Wiener, and Bar state that substances experimentally injected into the maternal veins may be found in the amniotic fluid without having first traversed the body of the fœtus.*

Symptoms and Signs.—The distention of the uterus, and the consequent abnormal expansion of the abdomen produced by hydramnion, results in an impediment to locomotion, and causes discomfort or actual pain by traction upon the abdominal parietes. The diaphragm is forced upward, and, encroaching upon the thoracic space, compresses the lungs and displaces the heart, thus producing dyspnœa and cardiac palpitation. The urine may become scanty and albuminous from impeded renal circulation. Neuralgic pains and œdema of the abdominal walls, of the labia and lower extremities, are produced by compression of the pelvic nerves and vessels. Vomiting and dyspeptic symptoms result from direct compression of the digestive organs or from reflex irritation of them. Ascites may be produced by obstruction of the portal circulation. Insomnia results from the patient's general discomfort and the deterioration of her health. In the acute form, vomiting is often incessant, the pain is intense, and febrile symptoms develop. Physical examination reveals in advanced cases an immensely distended abdomen. The uterus, which can be easily mapped out by palpation and percussion, is tense, elastic, and obscurely fluctuating. The fetal cardiac sounds are faint or imperceptible. The fœtus changes its position with unusual rapidity and facility. Combined manipulation shows the lower segment of the uterus to be elastic and tense, while the fœtus can not be readily felt by the finger placed in contact with the cervix. Pregnancy accompanied by hydramnion seldom reaches its normal termination, delivery being prematurely induced by death of the fœtus, by separation of the placenta, or by overdistention of the uterus. The first stage of labor is abnormally prolonged, because of the comparatively feeble contractions of the expanded uterine walls. Labor may become precipitate in the second stage, owing to the sudden escape of the amniotic fluid; and uterine inertia, in the third stage, frequently results in *post-partum* hæmorrhage. Involution is apt to be protracted and incomplete.

* *Vide* CHARPENTIER, Traité pratique des accouchements, p. 890.

Diagnosis.—Hydramnion may be mistaken for twin pregnancy, but is easily excluded by the rational symptoms, by the tenseness of the uterine walls, by the feebleness or absence of fetal heart-sounds, and by the difficulty experienced in perceiving the fœtus on palpation.

Prognosis.—The prognosis for the child is fatal in nearly one fourth of the cases. For the mother it is favorable, although the risk of *post-partum* hæmorrhage is considerable. This high mortality is due to malformations of the fœtus, to dropsical affections, to prematurity, and to the frequency of faulty presentations. Thus, of one hundred and thirteen cases collected by Charpentier, twenty-one presented by the breech, twenty by the shoulder, and two by the face.

Treatment.—The treatment embraces the application of an abdominal supporter and the injunction to refrain from active physical exertion. Grave disturbances of the mother's heart indicate the induction of premature delivery, which should, however, in the interest of the child, be delayed as long as is consistent with maternal safety. In parturition, the membranes should be punctured if the accumulated liquor amnii retards the dilatation of the cervix. Puncture must be performed in the interval of the pains, in order that the waters may escape gradually and leave the position of the child unchanged. After the expulsion of the placenta, the usual prophylactic measures against *post-partum* hæmorrhage must be promptly adopted.

II. **Abnormally Small Amount of Amniotic Fluid.**—The quantity of amniotic fluid may, even in some cases of advanced pregnancy, be so limited as to render the uterus unusually small and firm, and to limit the freedom of the movements. Under these circumstances, the movements are so plainly perceptible to the mother as to be the source of positive discomfort.

An abnormally small quantity of liquor amnii is, however, only of importance in the earlier stages of fetal development. If the amnion be not then separated from the fœtus by an adequate amount of fluid, abnormal amniotic foldings and adhesions between the amnion and the surface of the fœtus may take place.

The so-called fœto-amniotic bands* thus formed may, by mechanical compression, result in various fetal deformities, or in spontaneous intra-uterine amputation.

Anomalies of the Umbilical Cord.

I. **Torsion.**—Torsion consists in such a rotation of the umbilical cord upon its longitudinal axis that its vessels are thereby rendered nearly or quite impermeable. It occurs most frequently in fœtuses which have advanced beyond the middle period of normal utero-gestation, particularly, according to Spiegelberg,† in those of the seventh

* Först, Arch. f. Gynaek., Bd. ii, 171, p. 318.

† Spiegelberg, Lehrbuch, p. 350.

month. It is, however, often met with in fœtuses of an earlier age. Until a comparatively recent period, authors have unreservedly attributed torsion to active movements on the part of the fœtus, and regarded it as the cause of the latter's death. Martin * has shown that this theory is untenable for the majority of cases, because the patho-

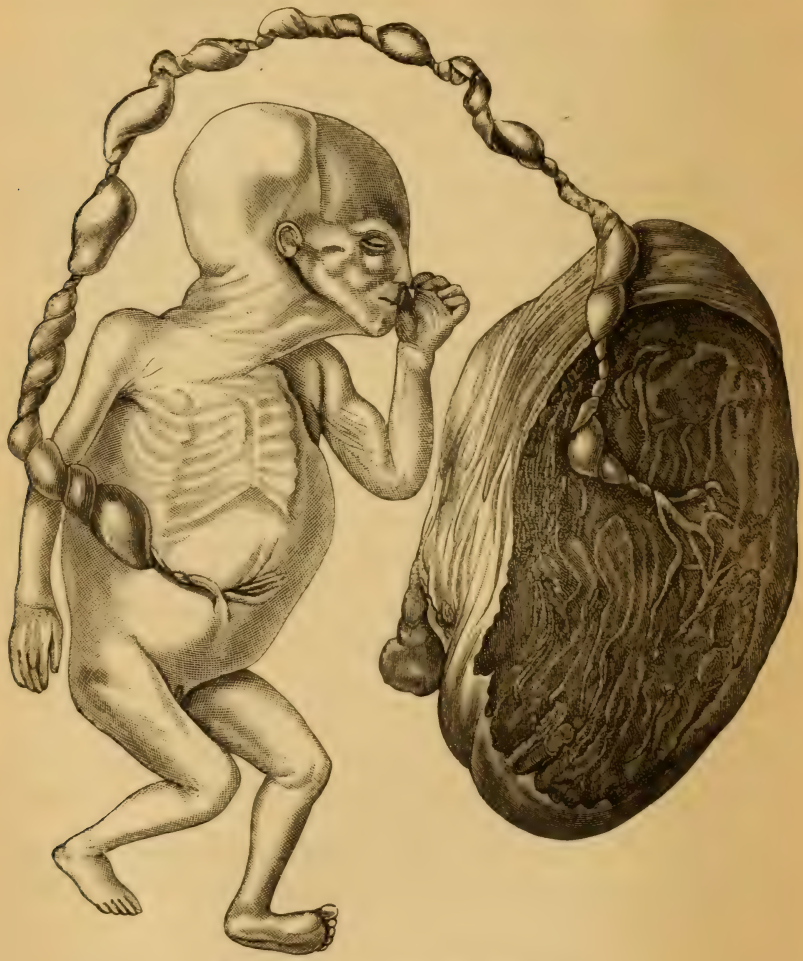


Fig. 131.—Torsion of the cord. (Schauta.)

logical conditions which result from fetal death induced by torsion, whether rapidly or slowly produced, are almost invariably absent. These morbid anatomical processes embrace rupture of the umbilical blood-vessels, and extravasations, for cases of sudden origin, and congestion, with œdema, for those more gradually developed. Martin

* Martin, Ztschr. f. Geburtsh. u. Gynaek., Bd. ii, Heft 2, 1878, p. 346.

therefore concluded that torsion was a *post-mortem* event, resulting from rotation of the fœtus produced by maternal movements. Ruge * earnestly advocated the same view, and suggested the various morbid changes due to syphilis, endometritis placentaris, and sub-placental hæmorrhage as the cause of fetal death in cases which subsequently developed numerous torsions. Schauta † appears as a recent champion of the same theory, although he admits that loose torsions, incapable of producing actual stenosis of the umbilical vessels, may often occur during the life of the fœtus. He bases his belief in the *post-mortem* occurrence of torsion—1. Upon the large number of twists often presenting themselves, any one of which would have involved the death of the fœtus. Even granting the original torsion to have been of *ante-mortem* origin, the others must then have occurred after death. 2. Upon the improbability of the formation of very numerous torsions in a healthy cord, inasmuch as its elasticity would lead to compensatory reverse rotation. 3. Upon the fact that even twenty-five artificially induced torsions resulted in rupture of the normal cord from excessive tension. Schauta regards the cysts found in connection with some torsions as insufficient proof of their *ante-mortem* occurrence. Torsions are more frequently present in the umbilical cords of male than in those of female fœtuses, and are sometimes surprisingly numerous. Schauta reports a case in which he observed three hundred and eighty rotations of the cord on its longitudinal axis. It occurs by preference in multiparæ, probably on account of the greater latitude afforded for fetal movements. Unusual length of the cord favors its occurrence, for a similar reason. The seat of the torsion is ordinarily in close proximity to the umbilicus. It occurs but rarely at the placental end or in the center of the cord. The umbilical vessels are usually nearly occluded at the seat of the torsion, but still permeable. Thrombi of varying consistency are often found in the vessels. Sero-sanguinolent fluid in the abdominal cavity of the fœtus, œdema, and cystic degeneration of the cord, are also pathological conditions frequently attending torsion.

Fig. 122.—Knot of umbilical cord. (Leyman.)

II. **Knots.**—Knots in the umbilical cord, which occur once in two hundred cases, may result from the passage of the fœtus through a twisted loop of the cord, whether the passage be effected during pregnancy by the spontaneous fetal movements, or at term by the uterine expulsive efforts, or by the manipulations of the *accoucheur*. Knots formed during parturition

* Ruge, *ibid.*, Bd. iii, Heft 2, 1878, p. 417.

† Schauta, Arch. f. Gynæk., Bd. xvii, Heft 1, 1881, p. 20.

are loose and easily untied. They are unattended by any diminution in the gelatin of Wharton. Those occurring during pregnancy are more closely and firmly drawn, and more difficult to loosen than the former variety. The cord is partly or completely denuded of the gelatin at the seat of the knot, and plainly shows the location of the latter, after its solution, by well-marked indentations. Knots in the cord, of either variety, are comparatively insignificant, although a tightly contracted one, in a thin cord, may occasion grave or even fatal disturbance of the umbilical circulation.

III. **Hernia.**—Hernia of the umbilical cord consists in the escape from the abdomen, at the point of insertion of the cord, of some or all of the fetal abdominal viscera. It is due either to arrested embryonic development, which prevents the complete closure of the abdominal cavity, or to the failure of the fetal intestines, originally situated outside the abdomen, to enter the same. Hernia of the cord may occur alone, in otherwise normally developed fœtuses, but is usually accompanied by other deformities, such as stricture of the rectum, imperforate anus, or distortions of the lower limbs and of the genitals, produced by traction of the displaced viscera upon adjoining parts. The contents of the hernial sac, which is composed of the amnion and of the peritonæum, are usually convolutions of the intestine, or these with a portion of the liver, although the kidneys, stomach, and spleen are sometimes also extruded, leaving the fetal abdomen nearly empty.

IV. **Coiling of the Cord.**—Windings of the umbilical cord around the fœtus, occurring during pregnancy, vary in their results with the rapidity of their formation. When rapidly developed, they may in rare cases lead to sudden interruption of the umbilical circulation, and to consequent death of the fœtus. Should the coils be gradually formed and firm, the extremity embraced by the cord increases, by its own growth, the tightness of the constricting ligature. The latter slowly lessens the caliber of the vessels supplying the extremity concerned, and finally, occluding them, produces death of the limb. Absorption of the soft and hard parts of the extremity may result from the cord's unyielding pressure, and the limb be thus completely severed from the trunk by so-called spontaneous amputation. In certain cases the combined pressure of the cord and of the slowly growing member may suffice to completely arrest the umbilical circulation, and thus produce the death of the fœtus. Should the neck be encircled by the cord, death may ensue from strangulation, and be followed in some cases by almost complete amputation of the head. Coilings of the cord around the fœtus occurring at birth are of little importance unless they be numerous. In that case they lead to a shortening of the cord, and produce anomalous positions, premature separation of the placenta, retarded second stage of labor, and even death of the fœtus from interference of the umbilical circulation.

V. **Cysts.**—Cysts of the umbilical cord within the amniotic sheath are either produced by liquefaction of mucoid tissue, or by accumulation of serum between the epithelial layers of the allantois.

VI. **Stenosis of Umbilical Vessels.**—Partial occlusion of the umbilical vein at the placental insertion, produced by new connective tissue resulting from circumscribed periphlebitis, is sometimes observed, but is not sufficiently marked to impede the umbilical circulation. Stenosis of the umbilical arteries is occasionally produced by atheroma and subsequent thrombosis. Stenosis of the umbilical vein,

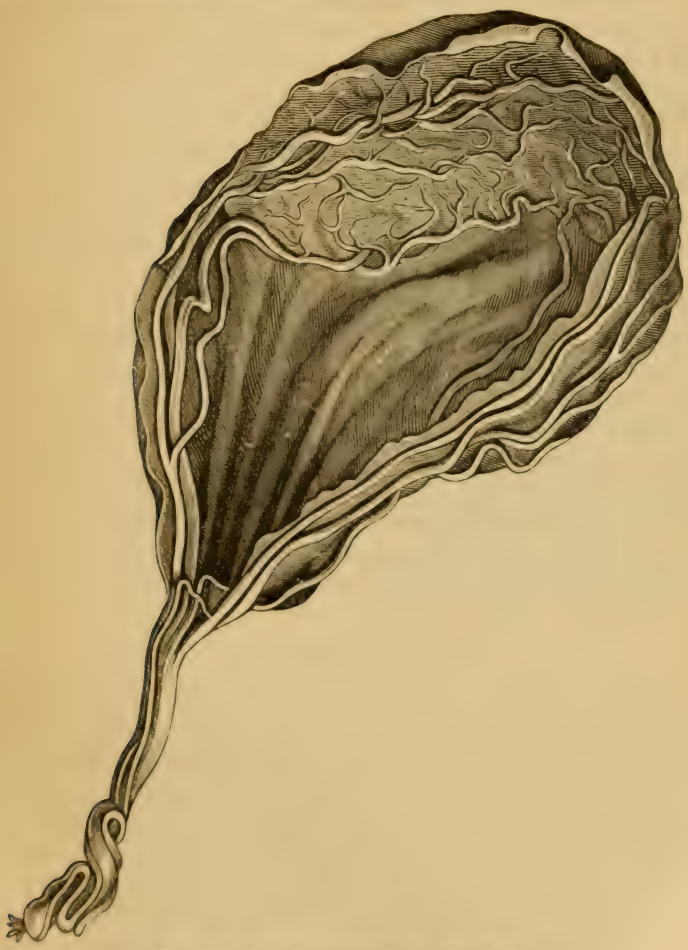


Fig. 133.—Insertio velamentosa. (Lobstein.)

and, more rarely, of the arteries, may also result from chronic phlebitis characterized pathologically by the growth in the intima of spindle-shaped and round cells, which later develop into new connective

tissue. This process, which is usually referred to hereditary syphilis,* may extend into the muscularis, and even invade the adventitia. The result of the stenosis of the uterine vessels is, of course, prejudicial to the fœtus in direct proportion to its grade of development.

VII. **Calcareous Degeneration.**—Calcareous deposits have been observed in the cords of syphilitic fœtuses.

VIII. **Marginal Insertion of the Cord.**—This anomaly is sometimes called the battledoor placenta, while the term insertio velamentosa is applied to cases where the vessels of the cord pursue their course for some distance through the membranes before reaching the placenta. To comprehend their origin, it is necessary to recall the main physiological processes involved in the normal development of the placental organ. The vessels of the allantois are not invariably carried at the outset to the point in the periphery of the ovum which the placenta will ultimately occupy. The vessels at first penetrate all the villi indiscriminately, but as the process of obliteration advances in those villi not destined to participate in the formation of the placenta, vascular connections are only preserved between the vessels of the newly formed cord and the villi attached to the serotina. As the amniotic sheath forms around the rudimentary cord, the fœtus performs a movement of rotation in such a way that the umbilical vessels are made to pursue a direct course toward their placental insertion. If, owing to the adhesions between the rudimentary cord and either the chorion or the amnion, the formation of the sheath is incomplete, the vessels diverge, and are distributed to points more or less distant from the placenta (Schultze). In the insertio velamentosa (Fig. 133), hæmorrhage sometimes results from a rupture of a vessel at the time of the breaking of the membranes—an accident which, unless speedily followed by delivery, is apt to prove fatal to the fœtus.

Hydatidiform Mole.

I. Morbid Anatomy.—Before the time of Cruveilhier, who is said to have first demonstrated the difference between true hydatids and the uterine hydatidiform mole, these morbid formations were regarded as identical. Since his researches, it has been considered established that the essential pathological process involved in the production of the hydatid mole consists in a proliferative degeneration of the chorionic villi. This degeneration of the villi embraces hypertrophy of their investing epithelium, of their connective-tissue cells, which may also undergo mucoid degeneration, and of their mucoid intercellular substance. The accumulation of the mucoid tissue imparts to the villi the appearance of cysts with translucent, semi-fluid contents, varying in size from that of a millet-seed to that of a walnut, and forming, by

* Mewis, Ztschr. f. Geburtsh. u. Gynaek., Bd. iv, Heft 1, 1879, p. 62.

their aggregation, growths which may attain the dimensions of a child's head, or in rare cases may reach such proportions as to distend the uterus to the size usual at the full term of pregnancy. Smaller collections are much more frequently encountered than those of these enormous proportions. The fluid of the cysts is albuminous, and closely resembles the liquor amnii, but contains in the earlier stages a larger proportion of mucin than the latter. At a later period the mucin is less abundant, while the albumen increases in quantity. The larger cysts are richer in water, but contain less mucin than the smaller ones. Inasmuch as the degenerative process does not attack the entire villus, portions of normal tissue intervene between the cysts, and impart to the degenerated mass the appearance of grape-clusters—the cysts representing the individual berries, and the unaltered tissues their connecting stems. A certain number of cysts are, however, attached to a single continuous pedicle, instead of possessing a separate stem connected with a common trunk, as is the case in the grape-cluster. If the mole be formed, as is usually the case, during the first month, while the villi are equally developed upon the entire periphery of the ovum, the degeneration will involve its whole surface. In this case the fœtus, dying and becoming disintegrated, may undergo complete absorption, leaving the amniotic cavity empty. The vessels of the villi are under such circumstances completely obliterated, while numerous blood-coagula are found between the cysts. If, however, the placenta be already formed at the beginning of the cystic degeneration, the villi having become atrophied upon that part of the chorion which does not participate in the development of the placenta, the neoplasm is confined, as a rule, to the latter, although cysts, evidently owing their origin to villi which have not undergone atrophy, sometimes occur upon the smooth surface of the chorion. Should the hydatidiform mole be of sufficient extent, under these circumstances, to destroy the fœtus, the more or less disintegrated remains of the latter are found in the amniotic cavity, which sometimes contains an excess of liquor amnii. If only a few of the placental lobes or single cotyledons be implicated, the growth of the fœtus may not be disturbed. A healthy

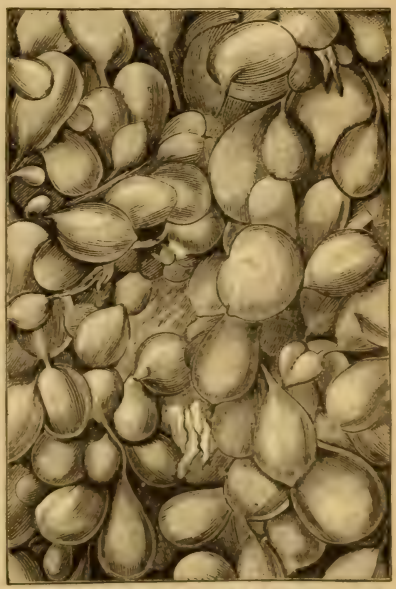


Fig. 134.—Specimen from hydatidiform mole, in the Wood Museum.

fœtus is occasionally developed side by side with a hydatid mole.* The hydatidiform mole is usually contained within the decidua. In an interesting case reported by Volkmann, however,† the degenerated villi had invaded the uterine blood-sinuses, and by pressure led to so extensive an atrophy and absorption of the uterine walls as to leave only a thin, transparent septum between the mole and the peritoneal covering of the organ. The cavity formed by this process of erosion in the uterine parenchyma was larger than the uterine cavity proper, and presented numerous intersecting trabeculæ resembling the columnæ carneæ of the cardiac ventricles. The destructive character of the cystic degeneration is attributed in such cases to some unknown morbid condition of the uterine walls, probably the result of malnutrition. Schroeder‡ refers to two similar cases, in one of which the cystic degeneration was attended by fatal peritonitis, and the other by rupture of the uterus, and death from hæmorrhage into the peritoneal cavity.

II. **Etiology.**—Primiparæ are less frequently affected by the hydatidiform mole than multiparæ, although the actual number of pregnancies seems to exert a less marked predisposing influence than advancing age. The cystic degeneration usually occurs during the first month of utero-gestation. According to Underhill,# the latter part of the third month is the limit within which the disease can originate. That the exciting cause of the hydatidiform mole may be a morbid maternal condition, is rendered probable by the repeated recurrence of the disease in the same patient, by its coexistence with inflammatory decidual disease or with extensive uterine fibroids, and by the presence, in the majority of cases, of a cancerous or syphilitic dyscrasia on the part of the mother. If the origin of the degeneration be maternal, as it probably is in most instances, the degeneration of the chorion antedates and produces the death of the fœtus. On the other hand, the fact that the morbid growth may owe its inception to fetal disease seems demonstrated by those cases in which, as has been already stated, a healthy fœtus may be developed at the same moment with a hydatidiform mole. This view is further supported by those cases in which death of the fœtus is attended by so insignificant an amount of chorionic disease as to render its active causative agency in the death of the fœtus highly improbable. Spiegelberg,‖ however, is of the opinion that the hydatidiform mole does not result from death of the embryo, and that its cause is often to be sought in an abnormal development of the allantois. The establishment of the true pathological relations of the hydatidiform mole have led to the abandonment of the once preva-

* Spiegelberg, Lehrbuch, p. 332.
† Volkmann, Virchow's Archiv, Bd. xli, p. 528.
‡ Schroeder, Lehrbuch, p. 429.
# Underhill, The Hydatidiform Mole, Obstet. Gaz., January, 1879, p. 16.
‖ Spiegelberg, Lehrbuch, p. 333.

lent opinion that the neoplasm might be developed independent of conception. The theory that a portion of retained placenta might become affected with the hydatidiform disease, has also been refuted by accumulated clinical evidence.

III. **Symptomatology.**—A leading sign of the hydatidiform mole consists in a failure of correspondence between the uterine enlargement and the computed period of utero-gestation. The uterus is usually larger at any given stage of pregnancy than it naturally would be in the course of normal gestation, but may be decidedly smaller in those cases attended by early demise of the embryo. Lumbar and sacral pains are prominent and distressing in proportion to the rapidity of uterine development. The uterus imparts a peculiar doughy feeling to the palpating fingers, and in rare instances plainly perceptible fluctuation. Individual parts of the fœtus can not be distinguished through the uterine walls. The lower segment of the uterus is remarkably tense. Ballottement yields negative results and fetal movements are absent, although they may be closely simulated by uterine contractions. The fetal cardiac sounds are diminished in intensity or are quite imperceptible. There is a discharge from the uterus, either constant or intermittent, consisting of disintegrated and unruptured cysts, cystic fluid, and blood, which, although usually not excessive, may be so much increased by uterine contractions induced by overdistention as to seriously impair the general strength, or even to induce death from exhaustion.

Abortion is usually produced by the mole before the sixth month, but the expulsion of the neoplasm may be delayed until the normal period of parturition, or even until a later season. The hæmorrhage and the characteristic discharge cease after the complete expulsion of the tumor, but retained portions of the same may give rise to protracted bleeding. It is often impossible to distinguish the local signs produced by the expulsion of a large hydatidiform mass from those observed after normal delivery.

Diagnosis.—In cases of limited cystic degeneration it is often impossible to diagnosticate hydatidiform mole. The symptoms upon which, in well-marked cases, the diagnosis is to be based are rapid increase in the dimensions of the uterus, the presence of obscure fluctuation, the impossibility of obtaining the fetal heart-sounds or of grasping any of the fetal members, negative result of ballottement, and uterine contractions, attended by the mucous or muco-sanguinolent discharge containing the characteristic cysts.

Prognosis.—The prognosis of hydatidiform mole is determined chiefly by the frequency and the violence of the attending hæmorrhages. It is not extremely unfavorable in the majority of cases. The existence of the peculiar form of cystic degeneration described as the interstitial, intraparietal, or eroding variety would, however,

naturally render the prognosis exceedingly grave. The fatality of this class of cases results from their tendency to produce a rupture of the uterus complicated by intraperitoneal hæmorrhage, peritonitis, or septicæmia. The life of the fœtus is almost invariably sacrificed.

Treatment.—The treatment is restricted to measures calculated to control hæmorrhage and to promote the expulsion of the diseased mass. Most writers recommend non-interference so long as the uterus remains passive. When contractions set in, the vagina should be tamponed, and ergot given in full and repeated doses, until the mole is expelled entire. The expectant plan is, however, not devoid of danger. In once case, where the patient suffered from labor-pains for several hours before I saw her, the loss of blood was excessive. I succeeded in removing with the hand, through the patulous cervix, an enormous quantity of cysts, sufficient to fill a wooden pail. This was followed by good contraction of the uterus and arrest of the hæmorrhage, but the patient died two hours later from shock and anæmia. Unless, therefore, the patient is so placed that professional assistance can be obtained at a moment's notice, the propriety of dilating the cervix so soon as the diagnosis has been established may well be considered. Dilatation should be effected by the steel dilator, or by the dilators of Barnes or of Tarnier, or even by tents, if care is taken to render them thoroughly aseptic.

After expulsion, or after the manual removal of the hydatidiform cysts, the uterus should be washed out with antiseptic fluids; or, in case of hæmorrhage, its inner surface should be swabbed with the perchloride of iron. The irrigation of the uterine cavity with water, to which only sufficient perchloride of iron has been added to give it a wine-color, has often a powerful styptic effect. Underhill recommends the continued employment of ergot after delivery, and, in cases of persistent hæmorrhage, the occasional introduction of the laminaria tent, and, if necessary, the employment of Thomas's dull-wire curette.

Retention in Utero of the Dead Fœtus.

In the normal uterus the causative conditions producing retention of the dead fœtus are not invariably identical. If the placenta remain adherent to the uterus after the demise of the fœtus, the continued vitality and uninterrupted development of the placenta sufficiently explain the fetal retention. When, however, all connection between the placenta and the uterus has been severed, retention is probably referable to the diminished irritability of those reflex nervous centers which control the expulsive uterine efforts. The duration of retention produced by adhesion of the placenta, in cases of single pregnancy, is protracted until such time as morbid placental processes impair the vitality of that organ and induce its separation. In multiple preg-

nancies, attended by death of one or more of the fœtuses, the latter are usually expelled with the healthy fœtus at term. They are, however, sometimes expelled earlier, and, in rare instances, later than the normal fœtus, and it may in general terms be stated that retention produced by placental adhesion very rarely exceeds the natural period of gestation. Retention due to diminished irritability of the reflex centers may be indefinitely prolonged. Liebmann * is of the opinion that all cases of retention protracted beyond the normal term of pregnancy belong in this category.

The pathological changes which the fœtus undergoes when retained in the uterus after its death vary with the condition of the membranes; 1. If their integrity be preserved, the most important pathological fetal conditions resulting from the retention are mummification, maceration, and fatty degeneration. 2. If the membranes be ruptured soon after the death of the fœtus, or if their rupture be the cause of the termination of fetal life, mummification may ensue; or, in the event of the entrance of air into the uterine cavity, the fetal tissues may undergo putrefactive changes. If mummification has already occurred, putrefaction does not take place.†

Mummification.—Mummification is most frequently observed in fœtuses whose death has apparently been the gradual result of inanition from inadequate blood-supply, this insufficiency of the nutritive fluid being often referable to torsion or constriction of the umbilical cord. Mummification affects by preference fœtuses dying during the middle stages of gestation. Liebmann ‡ suggests that this fact may be connected with the augmented rapidity of endosmosis, due to the larger percentage of saline ingredients then present in the amniotic fluid, or to the fact that torsion and stenosis of the cord are most liable to occur at that period of pregnancy. Mummification occurs chiefly in connection with twin pregnancies, one fœtus being fully developed while the other becomes mummified. In this case the presence of the dead fœtus does not usually excite expulsory uterine efforts before the normal termination of pregnancy is reached, when both fœtuses are simultaneously delivered. In certain rare instances the mummified fœtus may be expelled either before or after the healthy one, but its delivery is unattended by hæmorrhage or other unpleasant complication. When mummification affects a single fœtus, the retention is supposed to be due to abnormally intimate connection between the placenta and the uterus. Symptoms closely simulating those of abortion occur, but they subside before the product of conception is expelled, and probably even before the rupture of the membranes. The fœtus then becomes mummified, while the vitality of the placenta is

* Liebmann, Beitrag z. Geburtsh. u. Gynæk., Bd. iii, 1874, pp. 59, 63.

† Spiegelberg, Lehrb., p. 367.

‡ Liebmann, *op. cit.*, p. 54.

not impaired. Under these circumstances the retention is never prolonged beyond the normal period of gestation, and is thus distinguished from those cases of retention owing their origin to so-called "missed labor."

A mummified fœtus is flattened from compression. Its viscera are of soft consistency and of small dimensions. Its surface is shrunken. The peritoneal and pleural cavities contain a scanty and discolored fluid. The subcutaneous areolar tissue has disappeared, and the skin lies in direct contact with the muscles. The placenta, which is dry, yellowish, and tough, is the seat of fatty degeneration, and contains the residue of old extravasations.

Maceration.—The placenta of a macerated fœtus (fœtus sanguinolentus) is anæmic, soft, and friable. The cord, in which the vessels are permeable, is cylindrical, smooth, spongy, and inelastic. Its coils have disappeared. It is club-shaped at the fetal extremity, and its color is brownish red. The amniotic fluid has a peculiarly repulsive, sweetish, and sickening odor, unlike that of putrefaction. The fluid is rendered turbid and of a greenish-yellow color by the admixture with it of sero-sanguinolent fluid, and of meconium. The membranes, which retain their normal consistence for a long time, finally become friable, swollen, and discolored. A fœtus of only one to two months may be completely dissolved by the process of maceration. If the fœtus be more mature, its general form and the outline of its organs are preserved, but granular degeneration and disintegration of their anatomical elements are everywhere present. The epidermis is first affected by the process of maceration. It is separated from the corium by the formation of vesicles similar to those of pemphigus, which contain either a reddish, sero-sanguinolent, or a clear serous fluid. The corium is infiltrated with the same fluid, and presents the appearance of brownish-red macerated parchment. The subcutaneous areolar and adipose tissues are reddish and œdematous. The œdema is most apparent over the cranium, the abdomen, the feet, hands, and sternum. The entire body is flaccid, and assumes, under the influence of external pressure, curiously distorted shapes, being distended at some points and depressed or flattened at others. The cranial sutures are separated, the joints are disarticulated, and the periosteum has become detached from the long bones. The vessels are filled with dark, grumous blood. The serous cavities are distended with bloody serum. The brain is transformed into a grayish-red pulp. All the viscera are infiltrated and friable, the uterus and lungs preserving their normal consistence longer than the other organs. Pigment masses and fat-crystals are deposited in many organs. In rare instances the fetal organs become covered with a greasy substance composed of cholesterin and the margarates of soda, potassa, and lime. These saponified products are sometimes termed, collectively, *adipocere*. No trustworthy inferences can be

drawn from the appearance of macerated fœtuses as to the cause of their decease, since the gross pathological conditions are identical under all circumstances.* Apparent variations are due to the respective periods of retention. The rapidity with which the process of maceration occurs is variable, and its extent is therefore no criterion of the time at which the fetal demise took place.

Seventy-five per cent of macerated fœtuses are expelled, according to Ruge,† before the thirty-first week, and transverse or breech-presentations occur in nearly one half of all the cases.

The term *missed labor* was applied by Oldham to those cases in which, the uterine expulsive efforts having been ineffectually made at full term without other result than the escape of the waters, the uterine contractions finally subside, leaving the fœtus *in utero*. The causes of missed labor usually cited are abnormal absence of uterine irritability, or of that residing in the reflex nervous centers, obstructed labor, and unusually close adhesions of the placenta.

Note.—The occurrence of missed labor has recently been disputed by Müller (De la grossesse utérine prolongée indéfiniment, Paris, 1878), who would refer all such cases to gestations occurring external to the uterine cavity. Certainly the criticisms of Müller have greatly restricted the number of cases which formerly were unquestionably assigned to this category. In certain of them the fœtus appears secondarily to have made its way into the uterus through a communicating passage, while in others the pregnancy may have been primarily of tubo-uterine or of mural origin. Still, Barnes has since related the history of a case (On the so-called "Missed Labor," Obst. Trans., vol. xxiii, p. 81) which affords strong affirmative evidence of the possibility of the prolonged retention of a fœtus dying before the end of gestation was reached. The circumstances were briefly as follows: Mrs. B——, aged thirty-nine, had borne three stillborn children. Five years later, in the month of October, the catamenia ceased. The movements of the child were felt between the third and fourth months. Between the eighth and ninth months there was a flow of blood from the vagina, which, however, ceased in a few days under the use of cold and styptics. At the end of three weeks the bleeding returned, but became lighter at the end of a week, and then gradually disappeared. At no time were there labor pains. At the end of January pieces of bone began to come away, and portions of bone were removed by the finger and forceps after partial dilatation of the cervix. In February, under chloroform, Dr. Barnes proceeded to empty the uterus. As the hand could not be got through the uterus, Dr. Barnes extracted the fœtus with his craniotomy forceps. The fœtus was a compressed mass, bones emerging in the surface, the fleshy part greasy, soft, and putrid. It presented the appearance of having reached the eighth or ninth month of gestation. The patient showed considerable shock after the operation, but rallied the next day, and eventually recovered. Dr. Barnes was convinced, not only by examinations made during the extraction of the fœtus, but by the subsequent daily introduction of the sound, that the cavity was continuous with the cervix, and that the dense wall felt in no respect differed from the characters of uterine wall. To his mind, even a *post-mortem* examination could hardly have made the case clearer. In the discussion which followed Dr. Barnes's report it was, however, suggested by Sir Spencer Wells and others that the case was really one of mural pregnancy.

* Ruge, Zeit. f. Geb. u. Gyn., Bd. i, Heft 1, 1877, p. 58. † *Ibid.*, p. 70.

Dr. Stanley P. Warren, of Portland, Maine, sends me the following history, which seems conclusive: The patient menstruated last in January, 1884. In the following May she was attacked with general peritonitis. The 28th of October was computed as the probable terminus of gestation. At that time continuous cramp-like pains were felt by the patient. The presentation of the child was transverse. The cervix was not reached. For several days the pains recurred at night. By the second week in November it was ascertained that the child was dead. There was no further expulsive action. On December 30th, after vain attempts at dilatation of the cervix, Cæsarean section was performed, and a female child, weighing eight and a half pounds, was removed from the uterine cavity. The patient died from shock twenty-eight hours after the operation.

According to Küchenmeister (Ueber Lithopädien, Arch. f. Gynaek., vol. xvii, p. 153), retention may result from obstruction due to hardening of the cervix, to carcinoma, to fibroids in the lower segment, and where pregnancy takes place in the rudimentary cornu of a one-horned uterus. Retention due to obliteration of the cervical canal he rejects; but I have witnessed three cases of complete occlusion of the vaginal vault, where it was necessary to dissect up a long passage to permit the birth of the child, and where, without artificial aid, either rupture of the uterus or retention of the child must have resulted.

The pathological processes presenting themselves in case of long-continued retention and of missed labor vary with the entrance of air into or exclusion of air from the uterine cavity. If the atmosphere have free access to the uterus, the fœtus undergoes putrefactive changes. The soft parts, having been liquefied, escape, leaving the osseous framework of the fœtus *in utero*. This may also be gradually and partially disintegrated, liquefied, and expelled, but its complete evacuation is not often effected by Nature's processes. If, however, the cervix be narrow or unyielding, the continuous pressure of some projecting and pointed bone may penetrate its tissues and force an exit through the vagina, rectum, or anterior abdominal wall. A similar irritation and penetration may induce suppurative metritis, and, eventually, fatal peritonitis, or septicæmia.

If the air be excluded from the uterus in cases of retention indefinitely prolonged, the fœtus either becomes mummified, and, forming intimate connections with the uterus through the medium of inflammatory products, remains *in utero* without giving rise to any symptoms, or it may produce by constant irritation suppurative metritis, with abscess formation and the escape of pus externally. Access having been thus afforded to the air, putrefaction and its consequences will then ensue.

In rare cases of prolonged retention, the fœtus becomes the seat of adipocerous changes.* Calcification of the fœtus (lithopædion formation) occurs probably in cases of extra-uterine pregnancy only.

The retention of the dead fœtus is comparatively devoid of danger. Even if decomposition or putrefaction of the fœtus occurs, it is common for the products of disintegration to be eventually eliminated,

* *Vide* Case of Professor T. G. Thomas, N. Y. Med. Journal, vol. xxi, p. 163.

without a fatal result, by natural efforts or by the intervention of obstetrical art. There is good evidence, however, that the dead fœtus may, even if the access of air has been prevented, seriously impair the patient's health. Lately I have witnessed the development of albuminuria subsequent to the death of the fœtus, which disappeared upon the induction of premature labor.*

Unless, therefore, labor sets in within two or three weeks after the death of the fœtus, the induction of labor is indicated. The exception to this rule would be in cases of twin pregnancy, where one fœtus was still living. In prolonged retention, the elimination of pieces of bone should, as far as possible, be aided by the hand. If necessary to dilate the cervix, care should be taken lest spiculæ of bone be pressed by the expanding body into the uterine tissues. Every precaution should be taken subsequently to render the uterine cavity aseptic. When the Cæsarean section is performed and the uterine tissues are found extensively infiltrated, it has been suggested that the Porro operation may diminish the risks of infection. The efficacy of the measure would of course depend upon the freedom of the parametria from septic invasion.

CHAPTER XVI.

THE PREMATURE EXPULSION OF THE OVUM.

Causes of abortion.—Disposition to abortion.—Immediate causes.—Symptoms.—Moles.—Incomplete abortions.—Diagnosis.—Prognosis.—Treatment.—Prophylaxis.—Arrest of threatened abortion.—Treatment of inevitable abortion.—Treatment of neglected abortion.—Removal of fibrinous polypi.—Treatment of miscarriage.

When pregnancy is interrupted, during the first three months, by uterine contractions leading to the expulsion of the ovum, the term abortion is used; in the fourth, fifth, sixth, and seventh months—i. e., from the formation of the placenta to the time the child becomes viable—it is proper to speak of the accident as immature delivery, or miscarriage; and, finally, a confinement occurring from the twenty-eighth week, the earliest period of viability, to the thirty-eighth week, when the fœtus possesses every indication of maturity, is distinguished as premature delivery.

This purely artificial division is justified by practical differences in the symptomatology and treatment of the groups thus separately designated.

* *Vide* also Barker, On Puerperal Disease, p. 402. Kemper, Retention *in Utero* of the Dead Fœtus, Trans. Ind. State Med. Soc., 1875.

Causes which lead to the Premature Interruption of Pregnancy.

The underlying causes of abortion, miscarriage, and premature delivery are the same. Causes of abortion are rarely of sudden occurrence. Usually the way is prepared, either by changes taking place in the ovum, or by certain pathological conditions affecting the mother. In either of these ways a disposition to abortion is produced. When once, as the result of morbid changes, the attachment of the ovum to the uterus has been rendered insecure, causes usually inoperative suffice to determine uterine contractions and the time at which the expulsion takes place.

The Disposition to Abortion.—The disposition may be due primarily to any disease of the chorion, of which we have an example in syphilitic degeneration of the villi. In most cases, however, death of the fœtus precedes and leads to disease of the chorion. The causes of abortion resolve themselves, therefore, in large measure, into the causes which produce death of the fœtus.

The death of the fœtus may be due to direct violence, as kicks and blows upon the abdominal walls; to diseases of the fetal appendages (cord, amnion, chorion, placenta); to diseases of the decidua, especially those which give rise to hæmorrhage (before the complete formation of the placenta, the separation of the decidua from the uterus interferes with the nutritive supplies which go to the fœtus); to febrile affections, in which death results either from the high temperature, from associated diseased conditions of the decidua, or, as in certain acute infectious diseases, to the direct transfer of the poison from the mother to the fœtus; and, finally, to excessive anæmia. Anæmia developed by pregnancy rarely affects the child. In acute anæmia from profuse hæmorrhage, the child may die from asphyxia. In times of famine great numbers of women abort. The disposition to abort observed in corpulent women is probably due to the fact that the blood is insufficient in quantity and quality to supply the wants of the growing child.

The death of the fœtus is followed by the expulsion of the ovum, not usually at once, but after a longer or shorter period of time. Before the third month, in such cases of delay, the embryo, which consists of hardly more than a heap of cells, may become macerated, and absorption may take place after the death of the embryo. Except in cases of hydramnion, partial collapse of the ovum ensues. As soon as the fœtus dies, the circulation which passes from the fœtus to the chorion and placenta is suspended. The villi then become obliterated, and undergo fatty degeneration. The decidua is affected by the same process. With the diminution in the volume of the ovum, contractions begin. The villi, loosened in their attachments to the decidua,

are drawn out, and the decidual vessels, exposed and subjected to increased pressure, rupture, and hæmorrhage results. The uterine contractions are awakened and exercise an expulsive force upon the ovum, which in its descent expands the cervix from above downward, and passes finally into the vagina. In the first three months the ovum is not infrequently expelled with membranes unruptured. From the end of the third month onward such an occurrence is rare, though I have seen an instance which happened in the sixth month. In the early months the expulsion of an intact ovum is associated with inconsiderable hæmorrhage. When the membranes give way, the embryo and the fluid contents of the amnion escape first. With the removal of the compression exercised by the ovum upon the inner surface of the uterine walls, hæmorrhage occurs, which continues, as a rule, until the complete expulsion or removal of the membranes and placenta.

Aside from the death of the fœtus, with consecutive changes in the chorion and decidua, and diseases of the fetal appendages leading to death of the fœtus, the predisposition to abortion may be the result of primary defects or changes in the decidua alone. Of these changes we recognize :

1. *Atrophy of the Uterine Mucous Membrane.*—The insufficient development of the mucous membrane exercises an injurious influence upon the development of the ovum in cases only in which the serotina and the reflexa are involved. An abnormally small and undeveloped serotinal surface may give rise to a small placenta, or the serotinal attachment may be of such limited extent that the mere weight of the ovum drags it downward and converts it into a long, narrow pedicle. At other times, the reflexa may be but partially developed, or may fail altogether, and then the ovum, covered only by the chorion, hangs by a pediculated attachment to the serotina.

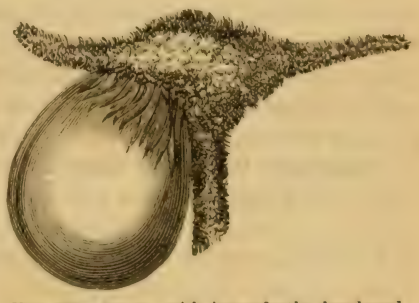


Fig. 135.—Ovum, with imperfectly developed decidua ; outer surface of vera. (Duncan.)

In both these cases the uterine contractions, instead of at once effecting the expulsion of the ovum, may force the ovum into the cervix, where it may remain for a time, nourished by the long pedicle, but arrested in its further descent by a contracted os externum. To these cases the term cervical pregnancy has been applied. The cervix, according to the month of pregnancy, is more or less spherically distended, and the corpus uteri above contracts down to nearly normal dimensions. As the cause of this condition lies chiefly in rigidity of

the os externum, it occurs most frequently in primiparæ. Even with a patulous os, though rarely, a cervical pregnancy may be produced by the resistance and firmness of the pedicle attaching the ovum to the uterus.*

2. *Hypertrophy of the Mucous Membrane.*—Thickening of the mucous membrane is the result of endometritis, and may lead to abortion in either of the following ways: The several forms of endometritis may give rise to affections of the placenta, and thus prove fatal to the fœtus, or the thinned, dilated vessels of the diseased decidua may rupture, and produce sanguineous effusions between the membranes.

The frequency of abortion in displacements of the uterus is principally dependent upon associated endometritis. In anteflexion of the uterus, sterility is common, but endometritis and abortion are rare. In retroflexion, on the contrary, while there is slight obstacle to conception, the congestion of the uterine walls and the altered conditions of the uterine mucous membrane render abortion a frequent occurrence.

Rigidity of the uterine walls, which interferes with their due expansion, may lead to premature uterine contractions. In this way an imbedded fibroid or carcinoma may ultimately become sources of abortion. Expansion of the uterus may likewise be hindered by old peritoneal adhesions or pelvic cellulitis.

Finally, there remains a class of women in whose cases it is impossible to detect either disease of the ovum or of the genital organs, yet in whom abortion occurs, dependent, so far as our present knowledge goes, upon certain personal conditions of nerve irritability. Physical and psychical sources of excitement which would be of small moment in some women, in them suffice to interrupt pregnancy.

Immediate Causes of Abortion.—Changes in the ovum other than rupture and escape of the amniotic fluid rarely lead at once and directly to abortion. The proximate causes which induce contractions and the throwing off of the ovum reside for the most part in the maternal system. They consist of:

1. *Hyperæmia of the Gravid Uterus.*—When the predisposing causes have operated to weaken the attachments of the ovum to the decidua, anything which determines the blood-currents to the uterus is liable to produce extravasations of blood around the ovum, and awaken uterine contractions. Because of this fact, we surround patients predisposed to abort with every precaution during the periodic menstrual congestion that not even pregnancy altogether suspends. Fevers, inflammatory affections of the genital organs, excesses in coitus, hot foot-baths, valvular heart lesions, obstructions to the circulation of the lungs and liver, may each lead to rupture of the decidual vessels.

* W. Schulein, Ueber cervicale Schwangerschaft, Ztschr. f. Geburtsh. und Gynaek., Bd. iii, H. 2, p. 408.

More frequently rupture follows jars to the body from vomiting, coughing, and straining, from railroad journeys, from violent exercise, from falls, and the like.

The importance of separating the predisposing from the immediate causes of abortion is shown by the impunity with which often perfectly healthy women, with no abnormal conditions of the generative organs, set all the usual restraints at defiance with the intent to interrupt an undesired pregnancy. M. Brillaud Laujardière relates the case of a peasant who took his wife, while *enceinte*, behind him on horseback, and started off with her at full gallop with the view of causing her to miscarry. Having thus thoroughly shaken her, he dropped her suddenly to the ground without slackening his speed. This brutal manœuvre he repeated twice without the least success.* On the other hand, women eager for offspring, after an abortion, sometimes lay undue stress upon slight imprudences, and make them the sources of morbid self-reproaches, which it becomes one of the functions of the physician to allay.

2. *Uterine Contractions produced by Influences which act directly through the Nerves.*—Of this we have examples in the contractions awakened by frictions of the uterus through the abdominal walls, in the reflex contractions produced by stimuli applied to the breasts, and in those excited by strong mental emotions.

Symptoms.—As the detachment and expulsion of the ovum can not possibly take place without rupture of the decidual or placental vessels, hæmorrhage becomes the constant and necessary result of every abortion. In the first two months the hæmorrhage resembles that of a profuse menstruation. Pain is present, in part due to uterine congestion, in part to the expulsion of blood-clots through the imperfectly expanded cervix. The latter pains resemble those of obstructive dysmenorrhœa. These symptoms last from four to five days. As the ovum passes away unnoticed, enveloped in the clots, or piecemeal with the decidua, women are apt to regard these early abortions as the normal recurrence of a retarded menstrual period.

After the second month prodromal symptoms are rarely wanting. Among these may be mentioned fullness and weight in the pelvis, sacral pains, frequent micturition, periodic labor-like pains, and a mucous or watery discharge. These, followed by hæmorrhage, indicate a threatened abortion. The hæmorrhage, if slight, may cease, and the pregnancy go on undisturbed. Usually, however, the hæmorrhage increases in amount, or after a brief cessation recurs. Contractions set in, which become more and more pronounced, until finally the ovum is expelled.

In a typical case of abortion, in which the ovum is thrown off entire, uterine retraction and hæmorrhage unite to effect the progress-

* T. Gallard, De l'avortement au point de vue médico-légal, Paris, p. 24.

ive separation from below upward of the decidua from the uterine walls. The ovum then, covered by the reflexa and the detached decidua, is gradually pressed downward, and dilates first the os internum, next the cervix, and finally the os externum. The ovum passes into the vagina, covered by the decidua vera, or drags the inverted decidua after it. The emptied uterus then retracts down, and the hæmorrhage ceases. The aborted ovum is surrounded with coagulated blood. In the first three months, when the death of the embryo has preceded by a little time the completion of the abortion, every vestige of the embryo may be found to have disappeared. Sometimes, in the third month, a small placenta with shrunken umbilical vessels may now and then be met with.

When the extravasation of blood upon the uterine surface of the vera is considerable in amount, the vera is sometimes broken through, and the blood effused between the vera and reflexa. Extravasation may likewise take place between the reflexa and chorion, either in consequence of the rupture of the reflexa, or from a hæmorrhage starting from the placenta, which finds its way along the outer surface of the chorion, and dissects away the reflexa. The pressure upon the ovum, unless it has previously undergone collapse as a result of the death of the embryo, leads to rupture and escape of the amniotic fluid. The retained fetal and maternal membranes, with the intervening layers of coagulated blood, form a mass termed a mole. When the blood coagula are fresh, the mass is termed the *mola sanguinea* (blood-mole), and when of older date the *mola carnosa* (fleshy mole). The cavity, which is lined by the amnion, has usually an irregular surface. It is very exceptional for extravasations to break through both chorion and amnion, and thus form clots in the amniotic cavity itself. Moles seldom exceed an orange in size, and usually are expelled between the third and fifth month.

In cases where abnormal adhesions attach the vera and serotina to the walls of the uterus, retained portions of the maternal membranes may remain after the ovum is expelled. In another class—and this is the rule after the third month—the fetal membranes rupture, and the embryo escapes with the liquor amnii. While ordinarily the retained portions quickly follow the discharge of the ovum or embryo, it frequently happens that the uterus retracts upon its contents, the cervix closes, and a period of repose follows. There is then produced what is commonly known as an incomplete abortion.

Incomplete Abortion.—The various contingencies arising from these cases of incomplete abortion are thus truthfully depicted by Spiegelberg:*

1. Most frequently hæmorrhage continues at intervals, spontaneous elimination gradually taking place as, through retrograde changes, por-

* Spiegelberg, Lehrbuch der Geburtshülfe, Jahr., 1877, p. 377.

tions of the retained membranes become successively loosened in their attachments to the uterus.

2. In exceptional cases the hæmorrhage ceases for a time entirely. For days, weeks, and even months, the woman appears quite well. Then suddenly strong contractions, accompanied by profuse hæmorrhage, usher in the elimination of the fetal dependencies. In a case of my own, three months elapsed from the occurrence of the first hæmorrhage, which took place toward the end of the third month, and was quite insignificant in amount, before the abortion was completed. Meantime, as there were progressive abdominal enlargement, supposed quickening, and milk in the breasts, the threatened abortion was believed to have been arrested. Total retention, with a long interval of repose, is thought to be due to complete adherence of the placenta, which continues to receive nutrient supplies from the uterus. Spiegelberg believes that a menstrual period is the usual time at which the discharge of the retained membranes takes place.

3. Of more frequent occurrence than the foregoing is the putrid decomposition of the retained portions. It occurs chiefly in cases where there is more or less complete loss of organic connection between the placenta and the uterus. Decomposition in the non-adherent portions is produced by the introduction of air during the escape of the embryo, or through the subsequent passage of the finger into the uterus, or, where portions of the ovum hang down into the vagina, by absorption of septic matter from the vagina upward into the uterus. As a result of putrid decomposition, the woman is exposed to septicæmia, and infection of thrombi at the placental site. Fatal results are, however, rare, as decomposition is usually a late occurrence, setting in, as a rule, only after protective granulations have formed upon the uterine mucous membrane, and after the complete closure of the uterine sinuses. Continuous fever, with intercurrent attacks of hæmorrhage, is, however, set up, but passes away finally with the gradual discharge of the decomposed particles, while the threatening symptoms subside. Still, now and then septic processes lead to an unfavorable termination. Local perimetritic inflammation is a common event.

4. Where there is a certain degree of relaxation with enlargement of the uterine cavity, the fibrin of the extravasated blood may become deposited about any uneven surface within the uterus and give rise to a polypus-shaped body, suggestive in its mode of development of the stalactite formations in calcareous caverns.* These so-called fibrinous polypi generally develop around the *débris* of an abortion, such as retained bits of decidua, placental remains, and portions of the fetal membranes. In some cases, likewise, thrombi projecting from the placental site become the base of a loose fibrinous attachment. Pla-

* Fränkel, Beitrag zur Lehre von fibrinösen Polypen. Arch. f. Gynæk., Bd. ii, p. 76.

cental polypi give rise ultimately to bearing-down pains and intercurrent hæmorrhages. They may even decompose, and endanger life by septic absorption.

The retrograde changes that take place in a uterus after an abortion correspond to those which occur in deliveries at full term. Where

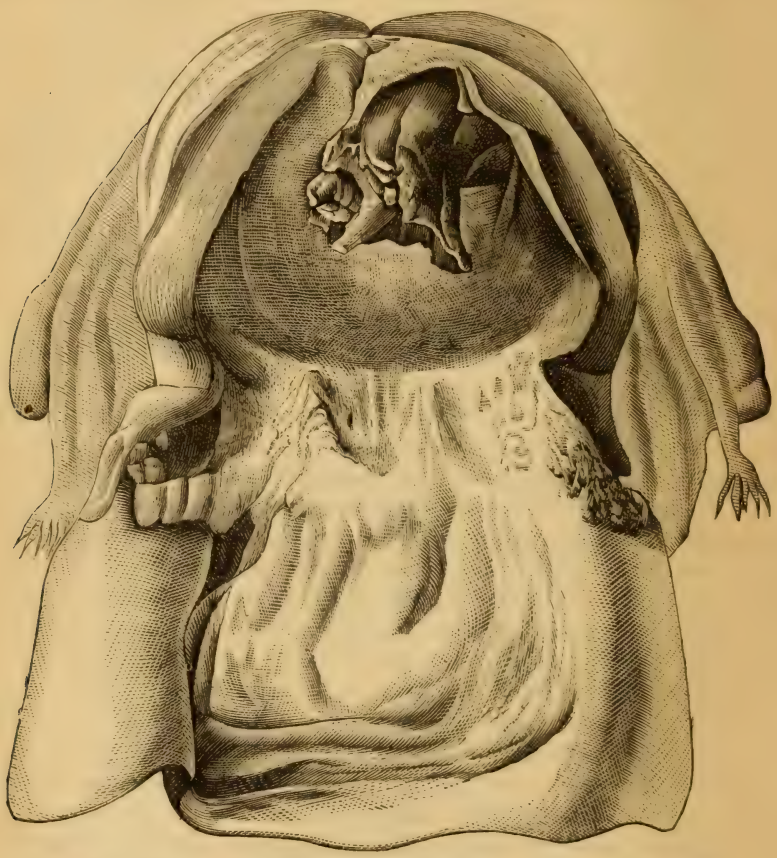


Fig. 136.—Uterus, with basis of a fibrinous polypus after an abortion. (Fränkel.)

a suitable plan of treatment is not adopted, or where the importance of care in the after-management is not adequately appreciated, subinvolution is apt to follow. Of all sources of uterine disease, none takes precedence of a mismanaged abortion.

Diagnosis.—The diagnosis is based upon the presence of pain, hæmorrhage, dilatation of the cervix, and the descent of the ovum. When the ovum can be felt through the patulous os the demonstration is of course complete. A soft polypus may, however, present a deceptive resemblance to a small ovum. In all cases of pregnancy the exist-

ence of hæmorrhage alone, even when disassociated from other symptoms, renders the probabilities of abortion sufficiently great to call for the exercise of every precaution. It is not easy to recognize pregnancy in the early months, but in doubtful cases the cessation of the menses should be regarded as presumptive evidence of its existence.

The diagnosis of these pathological changes in the ovum and deciduæ which pave the way for abortion can not be made out with certainty from mere subjective symptoms. Such changes may be regarded as probable when the size of the uterus does not correspond to the supposed period of gestation. Thus, if the uterus at the fifth month was no larger than is usual at the third month, the death of the embryo with arrest in the development of the ovum would be naturally inferred.

When the physician is summoned to a case of hæmorrhage occurring during pregnancy, he should at once examine the clots, where they have been preserved, for traces of the ovum. The clots should be broken up under water, and a careful examination made for floating fringes of villi. The ovum, when expelled entire, is usually enveloped in layers of coagulated blood, so that without thorough search it would easily pass unnoticed. If the coagula have been thrown away, and the physician finds upon his arrival the cervix closed, so that he can not pass his finger into the uterus to explore its cavity, it may be impossible at once to determine whether the abortion has taken place wholly or in part, or whether the entire ovum still remains *in utero*. The subsidence of all symptoms points, as a rule, to a complete emptying of the uterus, or to an arrest of the abortion, though in some cases it precedes mole-formation. A renewal of the hæmorrhage and the absence of normal involution indicate the continuance of the ovum in the uterus, or an incomplete abortion.

Prognosis.—The prognosis takes cognizance, of course, of the results to the mother only. In the first place, it may be laid down in the way of broad general statement, that all cases of spontaneous abortion (i. e., excluding criminal cases) not complicated with other morbid conditions are, under suitable medical guidance, devoid of danger. But, in the second place, it must be borne in mind that the statement is only true with the reservations that limit it, for in point of fact the actual number of deaths from abortion is by no means inconsiderable. Thus, the deaths from this cause reported to the Bureau of Vital Statistics of New York City between the years 1867 and 1875, inclusive, were one hundred and ninety-seven*—a number which falls short, in all probability, of the truth, by reason of the many circumstances which precisely in this condition tempt to concealment. The total number of deaths during the same period from metria was, according to the

* Lusk, Nature, Origin, and Prevention of Puerperal Fever. Transactions of the International Medical Congress, Philadelphia, p. 830.

reports rendered, 1,947. Hegar * reckons one abortion to every eight to ten full-time deliveries. If this proportion be correct, it would seem to show that the mortality from abortion is hardly second to that from puerperal fever itself.

Death, as a consequence of criminal abortion, is especially frequent. M. Tardieu found that in one hundred and sixteen such cases of which he was able to ascertain the termination, sixty women died.† But even in spontaneous cases death may take place from hæmorrhage, from septicæmia, or from peritonitis. In many instances the fatal termination is fairly attributable to the ignorance, the imprudence, or the willfulness of the patient. How far the dangers of abortion may be neutralized by proper medical assistance is best shown by the statistics of large hospitals. Thus, I gather from the reports issued by Dr. Johnston during his seven years' mastership of the Rotunda Hospital, in Dublin, that in two hundred and thirty-four cases of abortion treated in that institution there was but one death, and that not from puerperal trouble, but from mitral disease of the heart. Bellevue Hospital is the receptacle annually of a tolerably large number of women suffering from incomplete abortions, many of whom enter the hospital in a very unpromising condition from either excessive hæmorrhage or septic decomposition of the retained portions of the ovum. Yet, of the many patients whose histories I find in the record-books of the hospital since it has been customary to clear out the uterus in every case of incomplete abortion, all have recovered.

Treatment.—The treatment is divided into—1. Prophylaxis in cases of habitual abortion; 2. Arrest of threatened abortion; 3. Means adopted to avert the dangers of a progressing abortion.

Prophylaxis.—Prophylaxis considers the cause which underlies, in each case, the disposition to repeated abortion. One of the principal of these causes is syphilis in one or both parents. It is just in these cases that the triumph of the mercurial treatment has been most complete. The treatment should be addressed to the parent affected, or both parents should be subjected to the same treatment.

Among local conditions amenable to treatment may be mentioned endometritis, displacements, and perimetritic inflammations. In retroflexions and retroversions, the best results often follow the replacement of the uterus and the employment of a suitable pessary. No harm results from the use of pessaries during pregnancy. They should, however, be watched, on account of possible vaginal irritation. After the completion of the third month they should be removed, as the uterus then remains in place without artificial assistance. When backward displacement of the uterus follows abortion, reposition aids nor-

* Hegar, Beiträge zur Pathologie des Eies, Monatsschr. f. Geburtsk., Bd. xxi (supplement), p. 34.

† T. Gallard, De l'avortement au point de vue médico-légal, Paris, 1878, p. 45.

mal involution. When endometritis is secondary to extensive cervical laceration the Emmet operation is indicated.

In carcinoma and large fibroids treatment is powerless. Where, in such cases, sterility does not exist, happily for the mother, the associated morbid conditions of the uterine mucous membrane and the rigidity of the uterine walls lead commonly to the death of the ovum and premature uterine contractions. Where a small fibroid in the posterior uterine walls leads to sterility by the production of retroflexion, a pessary may, after replacement, at times be used with benefit.

One abortion sometimes follows another in rapid succession in newly married women. While the first abortion may have been due to some accidental cause, the sequence is often kept up by a morbid condition of the endometrium, generated by the shortness of the interval between the pregnancies, which does not allow time for the detachment of the decidua and the restoration of the membrane to a normal condition. In such cases, curetting is often of service, and a six weeks' abstention from sexual intercourse may be usefully enjoined.

In certain diseases of the placenta, in which the respiratory function of the organ had suffered any marked diminution, Sir J. Y. Simpson believed he had succeeded in averting the death of the fœtus by increasing the oxygen in the blood of the mother, through the administration of chlorate of potash.* Chlorate of potash may be given in doses of twenty grains, three times daily, for weeks at a time, without injury to the mother. Though it has not always rendered me the hoped-for service, the experience of other physicians, among whom I may mention Dr. Fordyce Barker, appears favorable to its employment.

In the class of cases in which abortion results neither from disease of the ovum nor of the uterus, but seems dependent upon some peculiar condition of nerve-irritability, the patient should not only avoid every known means of awakening uterine contractions, but should exercise the utmost caution at the recurrence of the menstrual epochs. Especially at the terminations of the second and third months a week's quiet in bed should be insisted upon. Dr. E. J. Jenks† recommends the viburnum prunifolium in cases where the habit of aborting has been formed. He writes: "My mode of prescribing the viburnum is to have the patient take from a half-teaspoonful to a teaspoonful of the fluid extract four times a day, beginning at least two days before the menstrual date, and continuing it not only during the usual period of the menstrual flow, but two days longer than that discharge continues when the woman is not pregnant." From the fourth month onward, the danger of the occurrence of abortion rapidly diminishes.

* Sir J. Y. Simpson, Obstetric Memoirs, edited by Priestley and Storer, Edinburgh, 1855, vol. i, p. 460.

† Jenks, Viburnum Prunifolium, Trans. of the Am. Gynæcol. Soc., vol. i, p. 130.

The Arrest of a Threatened Abortion.—Arrest may be accomplished in cases in which the death of the ovum has not taken place, and where the hæmorrhage arises from a slight detachment only of the decidua or placenta.

In every case of threatened abortion occurring in the early months, a careful examination should be instituted to ascertain whether retroflexion or retroversion exists. In the genu-pectoral position, replacement is easy. If the fundus is slowly raised by two fingers introduced into the vagina, so soon as the horizontal line is reached the uterus falls forward of its own weight. Replacement alone, in certain cases, suffices to relieve the congestion which furnishes the immediate cause of the abortion.

In a paper read by Dr. J. A. Doléris before the Obstetrical Section of the Ninth International Medical Congress, entitled The Treatment and Restoration of the Cervix Uteri during Pregnancy, that distinguished French accoucheur advocated the performance of trachelorrhaphy in certain cases of cervical laceration during pregnancy, as a means of averting threatened abortion.

The subject is of such importance, that I take this opportunity of relating the following personal experience:

Mrs. X. was married at the age of twenty. Ten months later she gave birth to a vigorous child, which weighed ten pounds. The cervix was torn on the left side to the vaginal junction. Three months after the birth of the first child she became again pregnant. Very early in pregnancy she had repeated attacks of hæmorrhage, with continuous sero-sanguinolent discharges. At the end of six months she gave birth to a child which lived for a few hours. The placenta was firmly adherent and was to a great extent impaired in its functions by the presence of white infarctions.

In childbed the uterus became displaced backward, so that its reposition was necessary. Owing to continued sanguinolent discharges, at the end of five weeks the uterine cavity was curetted. This was followed within four weeks by the symptoms of a new pregnancy. Again the patient had hæmorrhages, sero-sanguinolent discharges, and intermittent pains, and was confined almost constantly to her bed. As she was earnestly desirous of carrying her child to term, she eagerly accepted, when gestation was three months advanced, my proposition to perform Emmet's operation. The result was immediate. The pains, the discharges, the hæmorrhages ceased as if by magic. The patient felt herself perfectly well, and at full term gave birth to a girl weighing seven pounds.

Pain in the back during pregnancy should be regarded by women as a warning for them to temporarily abstain from their ordinary avocations. With ever so slight a hæmorrhage, they should at once be made to lie down and keep perfectly still. Simple turning in bed may start up fresh bleeding. Restlessness and mental excitement should be allayed by opiates in full doses. Ice to the vulva, cold cloths to the abdomen, and the internal administration of hæmostatics, are not indicated. The fluid extract of viburnum prunifolium is recommended by Dr. Jenks, in teaspoonful doses every two or three hours, as long

as its use seems to be demanded.* The author's somewhat limited experience has appeared favorable to the claims put forth for the viburnum as a uterine sedative. Where the foregoing measures prove successful, it is a safe rule to keep the patient in bed for a week after the final disappearance of the threatening symptons.

In cases of ascertained death of the fœtus, and in those of inevitable abortion, all measures calculated to retard the emptying of the uterus should be at once abandoned.

In the first four months there are no unequivocal signs of the death of the fœtus. From the middle of pregnancy onward death may be assumed, if, after repeated examinations, the absence of the fetal heart-sounds and fetal movements is confirmed.

The signs of inevitable abortion are profuse hæmorrhage, clots discharged from the uterus, dilatation of the cervix from the descent of the ovum, and a patulous condition of the os externum. Other symptoms consist of persistent uterine contractions, escape of the amniotic fluid, and the presence of the embryo or of portions of the ovum in the discharged clots. How far the ordinary signs may in given cases prove delusive, is shown by a remarkable one reported by Scanzoni, of a woman who was seized with profuse metrorrhagia in the third month of pregnancy. Great numbers of clots were discharged. As all hopes of saving the ovum were abandoned, ergot was used in large doses, a tampon was placed in the vagina for thirty-six hours, a sound was employed to explore the uterus, and finally, as the bleeding continued for three weeks, an intra-uterine injection of a weak solution of perchloride of iron was resorted to. Eight weeks later the patient quickened, and presented the distinctive evidences of a pregnancy advanced to the sixth month.†

The Treatment of Inevitable Abortion.

In the treatment of inevitable abortion it is proper to distinguish between cases of abortion proper and those of miscarriage. To avoid, however, needless repetitions, it is only points of distinctive difference to which, at the close, attention will be directed. The management of premature deliveries differs in no respect from that of confinement at term.

In the first two months little treatment besides rest in bed for a few days is ordinarily required. In the exceptional cases the treatment does not differ from that in the hæmorrhages of the non-pregnant uterus.

In the third month we distinguish—1. Cases in which the ovum is thrown off entire; 2. Cases in which the sac ruptures and the embryo escapes with the discharged fluid.

* Jenks, *loc. cit.*, p. 130.

† Scanzoni, Lehrbuch der Geburtshülfe, Wien, 1867, p. 83.

1. When in the third month the ovum is thrown off without rupture of the fetal membranes, the hæmorrhage rarely assumes dangerous proportions. The uterine contractions press the ovum into the cervix, which dilates, and, in primiparæ, becomes somewhat elongated. As the ovum descends, the body of the partially emptied uterus retracts. The effused blood coagulates in thin layers between the ovum and the uterine walls. The ovum forms a tampon, which fills the cervix and restrains the hæmorrhage.

No active treatment is, therefore, demanded. A carbolized vaginal douche may be used twice a day as a measure of cleanliness. All attempts to disengage the ovum with the finger should be avoided, as endangering its integrity. The vaginal tampon is unnecessary. It should only be used as a safeguard, where patients live at a distance from medical assistance and can only be visited at long intervals. As it is never certain that the rupture of the ovum may not take place during the course of its expulsion, the tampon may in such cases be employed in anticipation of a possible increase of hæmorrhage from sudden collapse of the membranes. In multiparæ the ovum seldom remains long in the cervix. In primiparæ, on the other hand, the tardy dilatation of the os externum may lead to a retention of the ovum in the cervix, lasting for days. As this condition is extremely painful, it is allowable to dilate the os externum with the index-finger, with Goodell's steel dilator, or even by incisions through the ring of circular fibers which furnish the cause of delay.

Small portions of the decidua vera sometimes remain attached to the uterine walls after abortion. They commonly do no harm, but are discharged with the lochial secretion. The amount of the latter after abortion is not usually large where the ovum has been expelled entire. It is for the most part watery, and does not usually last longer than a week. A protracted bloody discharge may, however, be maintained by decidual retention. This is most apt to result from meddlesome interference with the intact ovum, or in criminal abortion when the expulsion of the ovum has not been preceded by gradual changes in the decidual uterine attachments. The decidua can be safely and easily removed by means of the dull-wire currette. Peliminary dilatation of the cervix is rarely called for. As an after precaution against infection, cotton soaked in compound tincture of iodine should be passed into the uterine cavity by means of the ordinary applicator.

2. When the sac ruptures and the liquor amnii escapes, the removal of the pressure exerted upon the uterine wall by the intact ovum is followed by profuse hæmorrhage from the utero-placental vessels.

The diagnosis of rupture may be made either from finding the embryo in the clots, or, in the case of a dilated cervical canal, by the direct examination of the uterine cavity. Although after rupture

portions of the ovum may still be felt, we miss the smooth surface of the fluctuating amniotic sac. When the embryo can not be found, and the cervix is closed, profuse hæmorrhage alone would render the occurrence of rupture extremely probable.

The principles of treatment in these cases are very simple. The indications are, to check the hæmorrhage and to empty the uterus. As to the best methods of attaining these results, opinions widely differ.

When cases are treated with rest in bed, the internal administration of ergot, and cold cloths applied to the abdomen and vulva, the loss of blood is usually considerable, but the most of them terminate favorably. In some, however, the hæmorrhage may prove so severe as even to threaten life. Now, it is in every way desirable, for the future welfare of the patient, to restrain the hæmorrhage within the narrowest limits. The most effectual means of arresting the hæmorrhage is to clean out the uterus. If, therefore, the physician at the time of his visit finds the cervix sufficiently dilated to allow him to introduce his finger into the uterus, he should not hesitate at once to remove the retained portions of ovum. If the vagina is thoroughly disinfected and the hands are surgically clean, the operation is absolutely devoid of danger. It does not require any considerable amount of technical skill, while the immediate results are in the highest degree satisfactory. The patient should be placed crosswise in bed, with the hips drawn well over the edge. The legs should be flexed and the thighs held, where assistants can be obtained, at right angles to the body, to secure the greatest degree of relaxation to the perinæum and abdominal walls. The right index-finger should then be passed into the vagina and through the cervical canal, while the left hand, placed upon the abdomen, gradually presses the uterus down into the pelvic cavity so as to bring it within reach of the examining finger.* This portion of the act should be performed slowly, while every effort is made to divert the attention of the patient. Hasty manipulations invariably excite in the most willing of patients the full resistance of the abdominal walls. When the point of the finger reaches the os internum, it is sometimes necessary to pause for a minute or two to await a sufficient degree of dilatation to allow the finger to pass beyond the insertion of the nail. When the right finger is used, it should be made to pass upward with its dorsal surface along the left side of the uterus to the opening of the Fallopian tube, thence across the fundus to the right side. As the tip of the finger passes down upon the right side, it presses the detached

* Professor A. R. Simpson (Transactions of the Edinburgh Obstetrical Society, vol. iv, p. 227) recommends drawing down the uterus by means of volsellum-forceps attached to the anterior lip of the cervix. I have once seen extreme hæmorrhage follow this manœuvre (seventh month of pregnancy), and now feel some hesitation about its employment, at least in the later months.

ovum before it toward the os internum. By the time the finger has thus made the circuit of the uterus, the ovum is pressed into the cervical canal, and thence passes easily into the vagina. With the left finger, the movement is exactly the reverse. The finger passes first, with its dorsal surface directed to the right side, from the right Fallopian tube across the fundus, and downward along the left side of the uterus. The only resistance the finger meets is at the placental insertion, where a certain amount of manipulation is required to complete the detachment.*

Where the uterus can not be pressed down within reach of the index-finger by force exerted above the symphysis pubis, it is permissible to introduce the hand into the vagina; but, in such a case, the fingers are apt to become cramped, and freedom of manipulation is impaired. A better means of overcoming the difficulty consists in the administration of an anæsthetic. In cases of extreme anæmia chloroform should be discarded as too dangerous. Ether, however, has often seemed to me, on the contrary, to possess a stimulating action, and its use to be followed by increase in the volume and force of the pulse. The relaxation produced by the anæsthetic makes it easy to depress the uterus down to the pelvic floor, where it can be reached with comparative ease. After the removal of the ovum, the cavity of the uterus should be washed out with a stream of tepid carbolized water, in order to bring away any small detached portions of the ovum and decidua. In the manual extraction of the ovum, deliberation and perseverance are the main elements of success.

If, when the patient is first seen by the physician, the cervix is not sufficiently dilated to allow the finger to pass without force, the vaginal tampon should be employed. The tampon restrains the hæmorrhage, stimulates the uterus to contraction, and allows time for the employment of measures to rally a patient exhausted by profuse losses of blood. The material of which it is made is a matter of indifference, provided only it fills the vagina to its utmost capacity. In cases of urgent need, a soft towel, handkerchiefs, strips of cotton cloth, dampened cotton-wool, and the like, may be seized upon to meet a temporary emergency. The time-honored sponge, on account of its porosity, is least deserving of favor. When, however, the physician proposes to leave his patient for a number of hours, the mere hasty filling of the vagina through the vulva will not suffice. On the contrary, the highest degree of safety can only be secured by the closest observance of the rules of art.

The first essential of a good tampon is that it be carefully packed around the cervix uteri, and fill out the more dilatable upper portion of the vagina. This can be accomplished only by the aid of a speculum. The method I usually employ is one the credit of which, so far

* *Vide* Hüter, Compendium der geburtshülflichen Operationen, p. 22.

as the general features are concerned, I believe, belongs to Dr. Marion Sims. It consists in soaking absorbent cotton in carbolized water, (two per cent) and, after pressing out any excess of fluid, in forming from the cotton a number of flattened disks of about the size of the trade-dollar. After the vagina has been thoroughly washed with a carbolized or boric-acid solution the patient is placed in the latero-prone position, and the perinæum retracted by a Sims speculum. The dampened cotton disks are introduced by dressing-forceps, and, under the guidance of the eye, are packed first around the vaginal portion, then over the os, and thence the vagina is filled in from above downward until the narrow portion above the vestibule is reached. No other plan of tamponing with which I am acquainted can compare in solidity and effectiveness with this. Its removal is accomplished by the detachment with two fingers of a portion at a time. This part of the procedure is moderately painful. Many methods have been suggested to overcome in the removal the necessity of introducing the finger into the vagina. A very ingenious one consists in attaching the cotton to a piece of twine so as to form a kite-tail, which can be withdrawn by simply making tractions upon the extremity of the string left hanging outside the vulva. Professor I. E. Taylor uses a roller-bandage. It is efficient, and, like the kite-tail described, can be easily removed. Dr. F. P. Foster* advises the use of the lamp-wicking as a material for the tampon.

No tampon should be allowed to remain in the vagina much over twelve hours, and after its withdrawal, before proceeding to the examination of the uterus, the vagina should be cleansed by an injection of tepid carbolized water (℥ ij ad Oj). Often the ovum is then found in the upper portion of the vagina or filling up the cervix. If this is not the case, and the cervix is not dilated, so that manual extraction may easily be performed, another tampon should be introduced.

It is customary from the outset to sustain the action of the tampon by the administration of ergot, either in the form of the fluid extract (thirty drops every three to four hours), or of a solution of ergotin, given hypodermically (ergotin, gr. xij, glycerinæ, ℥ j, ten minims twice in the twenty-four hours. In women with abundant adipose tissue the injection should be made into the subcutaneous tissues of the lower abdomen. In others, the outer surface of the thigh should be selected).

If the patient is collapsed from loss of blood after tamponing, opiates, tea, and alcoholic stimulants should be administered, the latter in small but frequently repeated quantities, until the cerebral anæmia is relieved and the capillary circulation restored.

If, after the removal, the cervix is found not to be dilated, a third tampon may be introduced, and left *in situ* for another period of

* Foster, N. Y. Med. Jour., June, 1880.

twelve hours. The employment of the tampon is not, however, to be recommended for a period much exceeding twenty-four hours. Its continued use is apt to irritate the vagina. In spite of carbolic acid, it acquires an offensive odor. It generates septic matters, which, in the long run, creep upward through the cervix into the uterine cavity, and produce decomposition of the ovum. I prefer, therefore, in cases of undilated cervix, after twenty-four hours of vaginal tamponing, to resort to tupelo-tents. The tupelo-tent is most easily introduced when the patient is placed upon her left side, with the perinæum drawn back by Sims's speculum, and the anterior lip of the cervix drawn down and steadied by a tenaculum (Sims's method). It may, however, in the absence of an assistant, be introduced, with the patient on her back, by the aid of a pair of strong dressing-forceps. It should be long enough to pass well up through the os internum. Before use the tent should be immersed for a moment in carbolized water, and then dipped in iodoform. Within six to twelve hours the tent should be removed, and, after a preliminary vaginal douche, manual extraction be proceeded with in accordance with the rules already given.

In manual delivery it is desirable to remove the decidua as well as the ovum. When the cervix is patent this is easy, as the decidua is then detached from the uterine walls. When the cervix is unchanged the detachment is usually incomplete. In such cases it is advisable to resort to the curette, should the symptoms make action necessary.

Inside the uterine cavity ovum-forceps should be used with caution. I do not deny its serviceability or convenience on occasions. Its use, however, does not furnish the certainty that the uterine cavity has been completely emptied, which is obtained by the exploring finger. When, however, the retained portions of the ovum have for the most part left the uterine cavity, and occupy the cervical canal, the delivery may at times be advantageously hastened by placing the patient upon her side, and, with the cervix well brought into view by a Sims speculum, applying the ovum-forceps, under the guidance of the eye, within the cervix to the sides of the placenta (Skene). But great care requires to be exercised not to break away the fragile structures and leave material portions behind.

Under like circumstances, Hoening* recommended a modification of Credé's method for expression of the placenta. With the patient lying upon the back, the operator, according to Hoening, should seek to compress the body of the uterus between the left hand, laid above the symphysis pubis, and two fingers of the right hand introduced into the vagina. The measure is only practicable when the ovum has, to a great extent, passed from the uterine cavity. It is more likely to be followed by the retention of the decidua. As it is somewhat painful,

* Hoening, Scanzoni's Beiträge, Bd. vii, p. 213.

and requires for success lax abdominal parietes, it possesses a limited range of applicability.

Treatment of Neglected Abortion.—Where, following abortion, the uterus has once been completely evacuated, hæmorrhage ceases. A slight lochial discharge persists for a few days during the period in which the uterine portion of the decidua vera completes its period of repair. If, therefore, a patient comes to us two or three weeks after the supposed conclusion of an abortion, with the story of recurrent hæmorrhages taking place, as a rule, whenever she leaves her bed and assumes the upright position, it may be assumed, with an approach to certainty, that portions of the ovum still remain within the uterus. Oftentimes a fetid discharge points to the fact that decomposition has been set up. The absorption of septic materials may, furthermore, become the source of chills, of fever, and of great uterine tenderness. In most cases, with rest in bed, the contents are discharged by suppuration, and recovery ultimately takes place, but only after a slow, protracted convalescence, during which pelvic cellulitis and pelvic peritonitis occur as not uncommon complications. Hæmorrhages, peritonitis, and septicæmia may, however, bring the case to a fatal issue. The removal of the retained placenta and membranes is therefore indicated, not only as a measure calculated to promote recovery, but to avert possible danger to life.

With regard to the operation for removal, the rules already given are applicable. The following peculiarities should, however, be borne in mind. In case the retained portions are undecomposed, the cervix is usually found closed, and requires preliminary dilatation with the tent. When decomposition has once set in, the os internum will, as a rule, allow the finger to pass into the uterus.* When a decomposed ovum is removed by the finger, a chill and a septic fever—which rapidly disappear, however—are apt to follow in the course of a few hours. This chill and fever result from the slight traumatic injuries inflicted by the finger upon the uterine walls, whereby the capillaries and lymphatics become opened up to the action of the septic poisons. The fever ends in a short time, because the reservoir of supply is removed with the *débris* of the ovum. If the uterine cavity, after the operation, is carefully washed out with carbolized water, the septic fever is often averted. After the irrigation a strip of iodoform gauze pushed upward to the fundus with ovum-forceps acts beneficially both as a means of disinfection and as a safeguard against hæmorrhage. The packing can be left *in situ* for twenty-four hours. The improvement following the complete emptying of the uterus in these cases is so decided, that of late years I have not allowed myself to be deterred from proceeding actively, even when perimetritis and parametritis, in not too acute a form, already existed. In practice, multitudes of

* Hüter, Compendium der geburtshülflichen Operationen, Leipsic, 1874, p. 82.

examples show that the products of inflammations situated in the pelvis do not become absorbed so long as putrid materials are generated in the uterine cavity.

The removal of a fibrinous polypus, owing to its smoothness and the small size of the pedicle, is often a Sisyphus's task. The separation can only be successfully accomplished when the palmar surface of the index-finger presses from above upon the point of attachment. This necessitates a choice of hands. Thus, when the polypus is situated to the left, the right index-finger should be employed, and the left index-finger when the polypus is situated to the right. After the detachment is complete, it is necessary to press the polypoid body firmly against the uterine walls, and proceed with its withdrawal slowly. If, as is sometimes the case, the polypus slips from under the finger, the latter should be again passed to the fundus of the uterus, and the attempt repeated. Small portions, not larger than a pea, can be washed out by the uterine douche. When the polypus is situated near the os internum, the latter will be found patulous, but when it is well up within the body of the uterus, dilatation is a frequent prerequisite to removal.

For the removal of presumably small portions of retained ovum, especially in cases where, owing to inflammatory conditions, I have hesitated to make the circuit of the uterine cavity with my finger, I have succeeded admirably by employing a tolerably firm Thomas's wire curette.*

The Treatment of Immature Deliveries.—*Fourth to seventh month.* —Distinctive of immature deliveries are: painful periodic contractions, recognizable by the hand applied above the symphysis pubis, rupture of the membranes and discharge of the fœtus, the complete formation of the placenta and umbilical cord; while in abortion the uterine contractions are obscure, the placenta is rudimentary, and the ovum is frequently expelled entire. In the treatment of immature delivery the tampon may usually be discarded. After rupture of the membranes and expulsion of the fœtus, the hæmorrhage should be controlled by grasping the fundus of the uterus in the hand through the abdomen, and compressing the uterine walls firmly together.

The passage of the fœtus opens the uterus so as to allow, in the fourth and fifth months, the introduction of two fingers; in the sixth and seventh months, that of the half-hand. In case compression of the uterus does not arrest the hæmorrhage and expel the placenta, the cord should be carefully followed to its insertion, to determine the

* Skene, Med. Record, 1875, p. 59; Mundé, Centralbl. f. Gynaek., 1878, No. vi, p. 1. The patient should be placed in Sims's position, the perinæum should be drawn back with Sims's speculum, the cervix hooked down and steadied with a tenaculum, while the curette is made to pass over all portions of the uterine surface. Attached bits of placenta are recognized by the resistance they offer.

side upon which the implantation exists. If the placenta is implanted upon the right side, two or four fingers of the right hand, according to the degree of cervical dilatation, should be passed up along the left side of the uterus, across the fundus to the placental site. The detachment should be effected with the tips of the fingers, and the placenta pressed downward as the fingers descend along the right side of the uterus. The left hand should be employed in the reverse direction, when the placenta is situated to the right.

CHAPTER XVII.

EXTRA-UTERINE PREGNANCY.

Definition.—Tubal pregnancy.—Pregnancy in rudimentary cornu.—Interstitial pregnancy.—Tubo-abdominal and tubo-ovarian pregnancy.—Ovarian pregnancy.—Abdominal pregnancy. — Symptoms. — Terminations. — Diagnosis.—Treatment in cases of early gestation.—Cases of advanced gestation (fœtus living).—Cases of gestation prolonged after the death of the fœtus.

After coitus, the spermatozoa may make their way through the Fallopian tubes to the pelvic cavity. It is possible, therefore, for the ovum to become fecundated in any portion of the route from the ovary to the uterus. In exceptional cases, the ovum may, after fecundation, be arrested in its travels, and undergo development at some point outside the uterus. To these cases the term *extra-uterine pregnancy* has been applied.

In the past it has been assumed that the ovum may develop within the tube, in the ovary, or in the abdominal cavity—hence the terms *tubal*, *ovarian*, and *abdominal pregnancy;* but modern research has thrown doubt upon the existence of the two latter varieties, as a primary condition. In any event they are extremely rare.

In Mr. Tait's* belief, all cases of extra-uterine pregnancy are *ab initio* of tubal origin. When the ovum develops in the free part of the tube, rupture, he holds, occurs at or before the fourteenth week. If rupture occurs at once into the abdominal cavity, death ensues from hæmorrhage, or later from suppuration of the sac and peritonitis; if rupture takes place in the lower portion of the tube between the folds of the broad ligament, the ovum may develop to full term; may die and be absorbed as an extraperitoneal hæmatocele; may suppurate and be discharged at or near the navel, or through the bladder, the vagina, or intestinal tract; may remain quiescent as a lithopædion; or may become an abdominal pregnancy by secondary rupture. In the tubo-uterine or interstitial form death occurs from intraperitoneal rupture before the fifth month. Mr. Tait denies the possibility of a primary abdominal pregnancy. The ovarian form he regards as possible but not proved.

* Tait, Lectures on Ectopic Pregnancy and Pelvic Hæmatocele.

Tubal Pregnancy.—The ovum may find lodgment in any part of the tube. The cause of this anomaly is most frequently to be found in the various forms of chronic salpingitis. Owing to the associated loss of epithelium, the dilatation and other changes in the tube walls, the two active forces which propel the ovum through the tube—viz., ciliated movements and peristalsis—are weakened or destroyed, while free ingress is afforded to the spermatozoa. Or, again, the passage of the ovum may be interfered with by the secondary results of catarrhal inflammations—such as the production of mucous polypi, of adhesions, or of sac-like dilatations. Formerly great stress was laid upon the etiological importance of flexions and constrictions resulting from old peritoneal adhesions and inflammatory bands. Curiously enough, in recent laparotomies for tubal rupture this cause has not played an important part. It is not quite clear whether the peritonitis formerly observed so frequently at autopsies was not in most instances secondary. It is, moreover, possible that as a class, in cases where antecedent peritonitis has existed as a cause, the hæmorrhages resulting from rupture, owing to the agglutination of intestines and pelvic organs, are circumscribed, and do not call for surgical measures of relief.

Because of its connection with inflammatory processes, the occurrence of tubal pregnancy is often preceded by a long period of sterility. When the obliteration is only partial, the spermatozoa, owing to their small size, are not prevented from reaching the arrested ovum; when complete, on the contrary, they can only gain access to the ovum by first passing through the patulous tube, and then migrating across the rear of the uterus to the ovary or the open abdominal end of the tube upon the opposite side. In a considerable number of cases, the corpus luteum has been found upon the side opposite to the tube containing the fecundated ovum. With the present prevailing views,* this phenomenon is only to be accounted for by the hypothesis of the migration of the ovum across the peritoneal surface of the pelvis or through the uterus from one tube to the other.

Recent observations have shown that there is a tendency for tubal pregnancy to recur. Thus Herrmann has reported a case where, in performing laparotomy for tubal rupture, he found the remains of an ovum in the other tube. Tait † has reported one and Veit ‡ three cases where, within a year or two after a first operation for tubal rupt-

* Mayrhofer, Ueber die gelben Körper, und die Ueberwanderung des Eies, denies the whole doctrine of a distinct corpus luteum of pregnancy, and claims that corpora lutea are found at stated intervals, perhaps monthly, throughout the entire period of pregnancy. Leopold, Die Ueberwanderung der Eier, Arch. f. Gynaek., Bd., xvi, p. 24, however, found that after tying the right tube and removing the entire left ovary in a couple of rabbits pregnancy still took place.

† Tait, British Gynæcological Journal, August, 1888, p. 178.

‡ Veit, Gesellsch. f. Geburtshülfe und Gynaek. zu Berlin, May 10, 1889.

ure, a second laparotomy was rendered necessary because of the occurrence of pregnancy into the tube of the opposite side.

Tubal pregnancy is associated with the formation of a uterine decidua which differs in no wise from the decidua of pregnancy, except that the distinction into three layers is less marked.

In the tube a decidua likewise forms around the ovum. It contains large epithelioid cells, as in uterine gestation. It differs, however, from the latter in the presence of connective-tissue fibers between the cell groups, and in that next to the muscular coat there is a transition zone in which cells and muscular and connective-tissue fibers are intermingled. Klein * has reported the existence of decidual tissue between the villi in a specimen removed from a patient in whom rupture occurred seven weeks after the last menstruation. In more advanced cases there is no serotina, nor is there any maternal portion to the placenta. The club-shaped extremities of the villi simply impinge

Fig. 137.—Intraperitoneal rupture of tube.

on the muscular walls. Concerning the decidua reflexa opinions are conflicting. Frommel and Winckel maintain its existence. None was discovered by Langhans, Leopold, Klein, and the majority of later investigators. In Klein's cases tubal vessels opened directly into the spaces between the villi.

In the early months the development of the ovum leads to a spindle-shaped dilatation of the tube, associated with hypertrophy of the muscular walls due to increase in the length and thickness of the individual fibers. As regards the degree of hypertrophy, very great

* Klein, Zur Anatomie der Schwangeren Tube. Zeitschr. für Geburtshülfe und Gynæk., vol. xx, p. 288 *et seq.*

individual variations have been observed. Indeed, in the same sac a thickening at one point may be accompanied by an excessive degree of tenuity due to eccentric growth of the ovum at another. Now, the ultimate fate of a tubal pregnancy is in large measure dependent upon these anatomical differences. Unquestionably, early rupture is the

FIG. 138.—Rupture of tube between the folds of the broad ligament, as shown after section. The ovum is surrounded by coagulated blood.

rule. Mr. Tait says: "Out of an enormous number of specimens which I have examined, I have entirely failed to satisfy myself that rupture has been delayed later than the twelfth week." It seems to me, however, carrying skepticism too far to refuse credence to the positive observations of others, made apparently with the utmost care and with full

knowledge of possible sources of error, which seem to show that a tubal pregnancy may exceptionally reach advanced or even the full term of pregnancy. At present it seems fair to assume that, when the sac which surrounds the ovum is composed of muscular and connective-tissue fibers with an external peritoneal envelope, and directly communicates with the Fallopian tube, the sac walls are of tubal origin. Of course it is not possible to assert that no rupture has taken place in the course of development. It is only known positively that rupture occurring at the site of placental attachment gives rise to hæmorrhage fatal to the fœtus; and the same is true, with rare exceptions, where rupture occurs at any point of the peritoneal surface. That rupture has first occurred into the cavity of the broad ligament in all the cases which go on to the period of viability does not seem so absolutely certain. The anatomical appearances, in some instances at least, indicate that the exposure of the fetal membranes here and there through the maternal sac results not so much from laceration as from the gradual separation of the muscular fibers due to excessive stretching.* In most of the cases in which the pregnancy reaches an advanced stage the development of the tube takes place principally between the folds of the broad ligament. The support furnished the tubal sac by the gradual unfolding of the ligament layers hinders rupture. More rarely pregnancy may go to the period of viability without encroaching upon the intraligamentous space. The tumor then rises above the pelvic brim, and is furnished with a species of pedicle consisting of the uterine end of the tube and of the broad ligament.

The first of the above, or the intraligamentous form, lies close to the uterus, which it not infrequently crowds upward and forward. The uterine end of the tube varies greatly in length. The fimbriated extremity is unrecognizable. Usually no traces of the ovary are found. In the so-called pedicled form the uterus is crowded to one side or retroverted. The uterine end of the tube is usually long and thickened. The corresponding ovary has generally been discovered. In both cases the relations of the sac are often obscured by adhesions to adjacent viscera. In the second half of pregnancy rupture of the sac and the escape of the fœtus into the peritoneal cavity may occur without noticeable hæmorrhage or without interruption of pregnancy. As the pressure is removed by the escape of the amniotic fluid, the placental borders curl inward so as to furnish a cup-like space, while the membranes sink downward and cover the upper placental surface. The fœtus in these cases may occupy the abdominal cavity, or a sac may be formed by the agglutination of the adjacent viscera.

Werth has reported a case in which death of the embryo occurred in the second month, and was followed by hæmorrhage which poured

* *Vide* tables of Werth, Beiträge zur Anatomie und zur operativen Behandlung der Extrauterinschwangerschaft.

through the abdominal end of the tube into the pelvic cavity and gave rise to intraperitoneal hæmatocele. Similar observations have been made by Veit and Westermark. This form Werth terms tubal abortion. In another case described by Wyder the fimbriated extremity of the tube was obliterated, and as a consequence the hæmorrhage following the separation of the ovum converted the ampulla of the tube into a blood cyst the size of the fist.*

Pregnancy in the Rudimentary Cornu of a One-horned Uterus.—This anomaly so closely resembles the tubal form of pregnancy that the diagnostic distinction can rarely be established during life. In tubal pregnancy rupture takes place, as a rule, in the first three months, while the rupture of the cornu occurs somewhat later, usually between

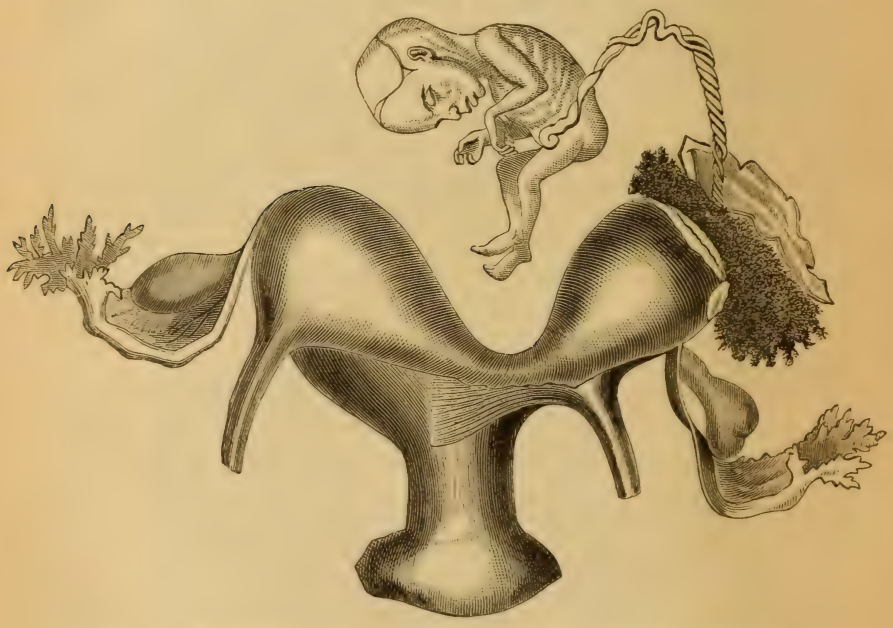


FIG. 139.—Pregnancy in rudimentary cornu. (Küssmaul, observed by Heyfelder.)

the third and sixth months. Cases have, however, been reported by Turner,† Werth,‡ and Salin,# in which gestation went to full term. Rupture takes place at the apex of the cornu. In several instances in which surgical procedures have been employed for this anomaly, the removal of the entire sac has been rendered easy by the presence of a well-formed pedicle.

Interstitial Pregnancy.—The term interstitial pregnancy is applied to cases in which the ovum is developed in the uterine portion of the

* *Op. cit.*, pp. 105, 106.
† Edinburgh Med. Jour., May, 1886, p. 974.
‡ Archiv f. Gynaek., vol. xvi, p. 281.
# Centralblatt f. Gynaek., 1881, p. 221.

tube. The latter measures about seven lines in length by one line in diameter. At first the muscular walls hypertrophy and form around the ovum a sac which projects from the upper angle of the uterus. As, ordinarily, the growth of the muscular tissue does not keep pace

Fig. 140.—Interstitial pregnancy. (Hennig.)

with that of the ovum, rupture occurs at an early period. Of twenty-six such cases collected by Hecker, all ruptured before the sixth month. Tait says that, "so far as known, interstitial pregnancy is uniformly fatal by primary intraperitoneal rupture before the fifth month." Schwarz,* however, reports a case belonging to this category in which the fœtus was expelled into the uterine cavity.

The patient was known to be pregnant. Repeated hæmorrhages indicated a threatened abortion. To avoid further dangers, the cervix was dilated with the view to empty the uterus. On examination with the finger the uterine cavity was found empty, but there was a piece of membrane at the uterine opening of the left tube, which was removed. The next day the finger detected membrane at the same site, and, beyond, a hard body. The uterus began to contract energetically. On

* Schwarz, Wiener med. Blätter, 1886. In the abstract furnished by Grandin in the American Journal of Obstetrics (January, 1887, p. 101), the date of pregnancy is not given. Similar cases have been reported by Dr. Charles McBurney (New York Med. Jour., March, 1878, p. 273) and by Dr. Cornelius Williams (in the December number of the same journal, p. 595), both of which were followed by the recovery of the mother.

the fifth day a fœtus was passed by the vagina, the pains ceased, the tumor largely disappeared, and the patient made a good convalescence.

Martin removed a male fœtus 33 centimetres long (six months) from the left uterine cornu. The patient recovered. Duvelius, who examined the specimen, concluded that the ovum had partially grown into the tube and between the folds of the broad ligament. He thought that rupture did not occur owing to the number of the muscular elements in the sac wall.*

A possible form of interstitial pregnancy is furnished by the occasional existence of a canal, open at its two extremities, and apparently a continuation or a bifurcation of the Fallopian tube. A case reported by Dr. Gilbert, in the Boston Medical and Surgical Journal (March 3, 1877), where the head of the child could be felt just above the os internum, covered by a thin mucous membrane, and in which delivery was successfully accomplished by an incision through

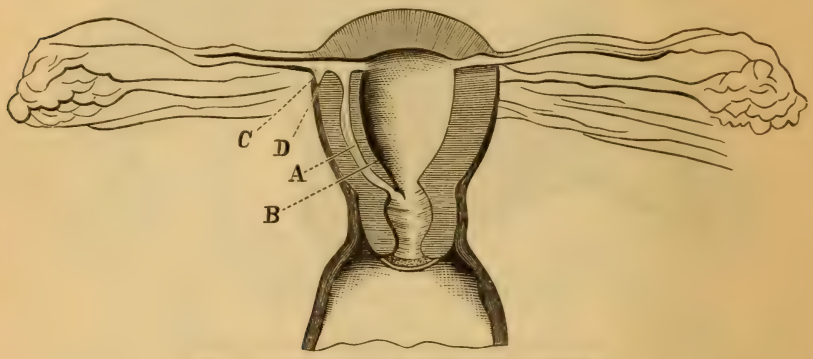


Fig. 141.—Bifurcation of tubal canal. (Hennig.)

the partition, probably belonged to this variety. A similar case, in the practice of Dr. H. Lenox Hodge, is reported by Parry (*op. cit.*, p. 266).

In the *post-mortem* examinations the distinction between an interstitial pregnancy and one in a rudimentary cornu is not easy to make out. The chief points of difference consist in the fact that in interstitial pregnancy the sac communicates by an orifice with the uterine cavity, or is separated from the uterus by a partition, while in pregnancy in a rudimentary cornu the two halves of the uterus are united by a muscular band, which is situated not at the upper angle but near the os internum.

Ovarian Pregnancy.—In spite of modern skepticism, there is little question as to the occasional occurrence of ovarian pregnancy. The specimen discovered by Patenko† in the Pathologico-Anatomical Museum of St. Petersburg seems to answer all the requirements of a

* Martin, Ztschr. f. Geb und Gynaek., vol. xi, p. 416.

† Patenko, Casuistische Mitteilungen, Arch. f. Gynaek., vol. xiv, p. 156.

demonstration. The right ovary was of the size of a hen's egg, and contained a cyst with smooth walls filled with serum. In this he found a body of a yellow color, of the size of a hazel-nut, which contained cylindrical and flat bones. The most careful microscopical examination established the fact that the bones were those of a fœtus, and not merely the chance products of a dermoid cyst. The presence of corpora lutea and follicles in the walls of the envelope proved that the body was an ovary. The tube on the corresponding side was nowhere adherent to the sac. The abdominal extremity was closed, and there were no traces of fimbriæ.*

Paltauf † relates a case of extra-uterine pregnancy in which there was a sacculated condition of both tubes which communicated with a cyst of ovarian origin. The ovaries were closely united. By means of the ovarian cyst a complete communication was established between the two tubes. In the large central ovarian cyst a clot was found which contained an embryo corresponding in size to one of from forty-five to forty-eight days' development. The origin of the condition here met with is naturally a matter of speculation.

Abdominal Pregnancy.—In most cases of abdominal pregnancy a connective-tissue proliferation is set up about the ovum, which surrounds it with a vascular sac. The latter often attains a degree of thickness which renders it comparable to the gravid uterus (Klob). The walls keep pace, as a rule, with the growth of the ovum, and, as they extend into the abdominal cavity, form adhesions to the intestines, the mesentery, and omentum. It is claimed that organic muscular fibers have been found in the sac, especially near the uterine attachment. In this form the fœtus most frequently reaches maturity.

In rare cases the ovum develops free in the abdominal cavity, without the formation of pseudo-membranes, the fœtus being surrounded solely by the amnion and chorion.

The greater number of so-called abdominal pregnancies are unquestionably of tubal origin. In reality they are for the most part extraperitoneal, and result from a rupture in the tube walls occurring between the folds of the blood ligament. In these cases the conditions are not incompatible with continued fetal development, and gestation may reach an advanced stage.

The question as to the occurrence of primary abdominal pregnancy must be regarded as unsettled. The discovery of an ovum growing in

* Mr. Tait, in his recent work on Ectopic Pregnancy, refers to a specimen described by Dr. Walter as one of primary ovarian pregnancy (sac had ruptured at fifth month, and fœtus had escaped into peritoneal cavity), which is now in the Dorpat Museum, and suggests a careful investigation as to its real character. At Werth's request this has since been made by Runge, with a complete confirmation of the significance given to it by Walter in his original publication. Werth, *loc. cit.*, p. 64.

† Paltauf, Arch. f. Gynæk., vol. xxx, p. 456.

the peritoneal cavity with the tubes and ovaries demonstrably intact would suffice to establish the abdominal variety. In the early months, before the anatomical conditions are obscured by secondary changes, there is no pretense that such proof has been obtained. In more advanced stages a good many cases of assumed abdominal pregnancy have been placed in evidence. These, so far as my investigations permit me to judge, are divisible into two classes:

1. Cases where the tubes are reported as intact, but in which there exists a direct communication between the tube upon the affected side and the sac cavity. Thus Treub, of Leipsic reports the following instance:

Patient menstruated last about the middle of April, 1887; peritonitic pains, with symptoms of internal hæmorrhage, on the 12th of June. At the end of July the same symptoms occurred, but were more violent. Ballottement was distinct by the end of September. Life was felt a week later. There were no fetal movements after November 24th. Septic symptoms developed, and laparotomy was performed January 22, 1888, when the patient was nearly moribund. Death ensued the following night.

At the autopsy the annexa on the right side were normal. The left tube measured ten centimetres and a half, which corresponded to the length of the right tube. It was pervious throughout its entire extent. The fimbriated outer end communicated with the sac. There was no apparent distention of the abdominal end of the tube. The sac of the ovum was adherent to the posterior surface of the uterus and of the broad ligament, to a few coils of intestines, to the sigmoid flexure, and to the rectum.

Abdominal pregnancy was assumed by Treub because the tube had its normal length and its natural direction, while the placenta was attached to the posterior sac wall, which contained no muscular elements, even in the vicinity of the tube. It has been suggested, however, that this was a case where the fecundated ovum occupying the infundibulum ruptured the tube walls at an early period of its growth, and thence continued its development between the folds of the broad ligament. It will be remembered that there were unmistakable symptoms of internal hæmorrhage in June and in July. The length of the left tube does not affect the question, as Werth * furnishes cases of unmistakable intraligamentous development where the same feature was noted.

2. Cases where the tubes are reported as intact and not in commu-

* Werth, Beiträge zur Anatomie und zur operativen Behandlung der Extrauterinschwangerschaft, 1887. *Vide* Table A, containing sixteen cases of intraligamentous tubal pregnancy. In No. 9, Scott's case, the length of the tube was given at six inches; in No. 12, Dreesen's case, at fifteen centimetres; in No. 15, Martyn's case, the statement is made that the tube was enormously increased in length.

nication with the sac. Few of these merit criticism. Lately, however, new interest has been excited as to the possibility of primary abdominal pregnancy by a case operated upon in 1879 by Professor Müller,* of Bern. Extra-uterine and intra-uterine pregnancy existed at the same time. At the eighth month spontaneous expulsion of the intra-uterine fœtus took place. The extra-uterine ovum was removed by laparotomy. Death ensued from hæmorrhage. The post-mortem investigation was conducted by Walker, who, in a carefully prepared essay, concludes that the case was a typical one of abdominal pregnancy. The tubes and ovaries were in contact, but not adherent to the sac. The latter had started originally from the bottom of the *cul-de-sac* of Douglas, and only in the course of its subsequent development had reached the uterine appendages. The correctness of the author's deductions has not, however, passed unchallenged, most of the recent reviewers regarding the history as indicating a tubal origin.

Schlectendahl † reports the discovery of an ovum near the spleen, containing a fœtus measuring fifteen centimetres in length, in a woman who had died from internal hæmorrhage. The sac was the size of a man's fist, and was surrounded by adherent intestines. The uterus and tubes appeared normal. The value of this case as evidence on behalf of abdominal pregnancy has been denied, but the facts related by Schlectendahl certainly call for explanation.

Of very great interest are the cases of so-called secondary abdominal pregnancies, where rupture of the sac and the fetal membranes takes place and the fœtus passes into the abdominal cavity. Most often the child dies at or soon after the time of rupture, but cases are reported by Walter, Patuna, and Bandl,‡ where it continued to develop within the abdomen. The presence of the child usually excites an active proliferation of connective tissue, by means of which a secondary sac is formed, though in Jessup's case the child was absolutely free in the abdominal cavity. If the child dies, it may either become converted into a lithopædion, or, through the vascular connective tissue by which it is surrounded, the soft structures of the body may preserve their integrity for years succeeding the fatal ending.

There are, in addition to the varieties already mentioned, histories on record of the coexistence of extra-uterine and intra-uterine pregnancies, the latter occurring at the same menstrual period as the former, or subsequent to the death of the extra-uterine fœtus.*

* *Vide* L. Bruhl, Zur Casuistik der Extrauterinschwangerschaft, Arch. f. Gynæk., vol. xxx, p. 70, and Walker, Der Bau der Eihäute bei graviditas abdominalis, Virchow's Arch., vol. cvii.

† Schlectendahl, Ein Fall von graviditas abdominalis, Frauenarzt, 1887, No. 2.

‡ Bandl, *loc. cit.*, p. 63.

* *Vide* Browne, Contribution to the History of Combined Intra-uterine and Extra-uterine Twin Pregnancy, with an Analysis of Twenty-four Cases, Trans. Am. Gynæc. Soc., vol. vi, p. 444.

Tubo-Abdominal and Tubo-Ovarian Pregnancy.—When the ovum becomes lodged near the trumpet-shaped extremity of the Fallopian tube it may grow outward into the abdominal cavity. Local peritonitis is then set up, and plastic exudation is thrown out, forming an envelope around the ovum, which is likewise bounded by the contiguous organs. In this way the ligamenta lata, the ovaries, the mesentery, the intestines, the bladder, and the uterus, may all contribute to the investment of the fetal membranes. In case of rupture in the tubal portion inflammatory products may form, and limit the extent of the injury. At first, owing to its weight, the distended tube drops into the *cul-de-sac* of Douglas. In advanced pregnancy, the spleen, kidneys, and liver may become involved, and form part of the sac-walls around the ovum. Usually the placenta is developed in the pelvic cavity.*

When the investment of the ovum is furnished by the tube and the ovary, the term tubo-ovarian pregnancy is employed. The course in either case does not materially differ from that of an abdominal pregnancy.

The Symptoms of Extra-uterine Pregnancy.

The earlier symptoms of extra-uterine pregnancy do not materially differ from those of the intra-uterine form. Menstruation usually ceases, though not with the same regularity as in normal pregnancy. The recurrence of the monthly flow for one or two periods is not an uncommon incident. In some cases, too, a nearly continuous sero-sanguinolent discharge of moderate extent has been observed. Up to a certain point the hypertrophic changes of the uterus take place in the usual manner. The mucous membrane is converted into a decidua, and a mucous plug fills the cervix. In general terms, the length of the uterus is greater the closer the contiguity of the ovum to the uterus. In a few cases of tubal pregnancy there has been no increase in the size of the uterus. The extra-uterine ovum may, in the course of its growth, drag the uterus upward, or push it downward, forward, or to the side, according to the site of its development.

Characteristic symptoms of extra-uterine pregnancy do not occur until the ovum has reached a certain degree of growth, and in some cases not until rupture has taken place. Often preceding rupture, or, in abdominal pregnancies, the death of the fœtus, the patient suffers from paroxysmal pains in the sac, and uterine pains of a labor-like character. The latter are associated with a sero-sanguinolent discharge, and are followed by the expulsion of portions of the decidua.

The symptoms of rupture are the usual ones of internal hæmorrhage, viz., yawning, languor, fainting, clammy perspiration, rapid pulse, intermittent vomiting, collapse, and acute anæmia. After the

* *Vide* Bandl, Billroth's Handbuch der Frauenkrankheiten, 5ter Abschnitt, p. 47.

death of the ovum these symptoms may cease and not return again; whereas, if the ovum continues to grow, there may be repeated attacks of hæmorrhage and local peritonitis.

When the death of the ovum does not occur within the first three to four months, the pressure of the tumor usually gives rise to dysuria and constipation.

Terminations.—The investigations resulting from the recent widespread interest in the diseases of the uterine appendages have shown that tubal pregnancy is by no means of rare occurrence. Whereas, in tubal and interstitial pregnancies, it was formerly believed that the usual terminations were rupture of the sac, hæmorrhage, peritonitis, and death, it is now known that in a pretty large percentage of cases the ovum perishes at an early period of development; and, though the sequelæ of these so-called tubal abortions may cause discomfort or lay the foundation for chronic invalidism, they do not necessarily lead to a fatal result. As in cases of uterine abortion, the death of the ovum is for the most part followed by hæmorrhage, which may be confined to the tube (hæmatoma tubæ), or the blood may escape by the fimbriated extremity into the peritoneal cavity, or, if circumscribed by adhesions, it may give rise to the intraperitoneal form of pelvic hæmatocele. Even when rupture takes place the hæmorrhage is not necessarily fatal. Mr. Tait insists on the relative harmlessness of most cases of hæmatoma due to rupture occurring between the folds of the broad ligament; while the records of salpingotomy show that, even with intraperitoneal rupture, the hæmorrhage has often been found moderate in amount, and did not in itself furnish the occasion for surgical interference.*

In abdominal pregnancies, which it has been seen are usually if not always secondary to the tubal form, the ovum or fœtus, as a rule, excites a local peritonitis, attended with pain and fever, and followed by the production of pseudo-membranes, which exercise a conservative influence by shutting off the ovum from the peritoneal cavity. Indeed, in the exceptional instances where these inflammatory conditions do not develop, the movements of the fœtus within its own membranes may give rise to such intense suffering as to cause the woman to die from exhaustion (Schroeder).

In abortions at an early stage it often happens that no trace of the embryo is found, and the diagnosis has to be made from the presence of the chorionic villi. Even when abortion does not occur in the first few weeks the child is apt to die prematurely. Sometimes, however, gestation may advance to full term; in which case labor-pains set in, the decidua is expelled, and the child dies during the expulsive efforts. In the majority of cases the dead fœtus excites a suppurative inflammation in the sac by which it is inclosed, and the patient dies

* *Vide*, as an instance, the cases reported by Orthman from Martin's Clinic.

either from general peritonitis or from profuse suppuration. In cases where the peritonitis remains local and the suppuration is tolerated, fistulous communications may form with one of the hollow viscera or the abdominal walls, through which the contents of the sac may be eliminated. Most frequently the opening takes place into the large intestine; quite often through the abdominal walls; more rarely into the vagina and bladder. In any case, the process of elimination is slow, often lasting months, and even years. When the bones and soft tissues have all been discharged, complete recovery may take place. In the larger proportion of cases, however, if Nature is not assisted, the patient perishes from exhaustion and blood-poisoning before the elimination is ended.

Sometimes the foregoing inflammatory changes do not occur as the result of the death of the fœtus, in which case the fluid contents of the sac are re-absorbed, and the walls collapse and come in contact with the fetal cadaver. The skin of the latter, and at a later period the deep-seated soft tissues, undergo fatty degeneration, and form a greasy substance consisting of fat, lime-salts, cholesterin-crystals, and blood-pigment. Afterward the fluid portions are absorbed, so that nothing remains but the bones, lime lamellæ, and incrustations upon the walls of the sac; or the fœtus may shrink up like a mummy, preserving its shape and organs to the minutest detail. A fœtus thus altered is termed a lithopædion. It may remain imbedded in connective tissue for years without injury to the mother. The lithopædion of Leinzell was removed in 1720 from a woman ninety-four years of age, who had carried it for forty-six years. The presence of the lithopædion does not prevent pregnancy from taking place. In some cases it may after years excite suppuration, a result which is fostered, according to Spiegelberg, by pregnancy and labor. Recovery may follow the artificial extraction of the foreign body, or death may result from inflammation and the discharge of pus.

Note.—Küchenmeister (Ueber Lithopädien, Arch. f. Gynaek., vol. xvii, p. 153) distinguishes three conditions to which the term lithopædion is applied:

1. Where, after absorption of the fluid, the membranes alone calcify, and the fœtus undergoes mummification.

2. Where, after absorption or escape of the fluid, the membranes calcify, and calcification of the fœtus occurs at points where the membranes adhere to the fetal surface.

3. Where the fœtus escapes into the abdominal cavity, and cretaceous matter is deposited in the smegma covering the fetal surface. In this way calcified strata form around the fœtus and exert compression upon the contained tissues. Beneath the chalky layers the tissues are mummified. A lithopædion in the sense of a complete petrifaction does not exist.

Diagnosis.—The diagnosis of extra-uterine fetation is based upon the existence of the signs of pregnancy, the exclusion of an ovum within the uterine cavity, and the presence of a tumor external to the uterus.

In practice, however, there is a wide-spread difference of opinion as to the practicability of an early diagnosis of tubal pregnancy. Dr. Hanks has recently stated his belief that a diagnosis can be made in ninety-five per cent of the cases we are called upon to attend. Mr. Tait, on the other hand, thinks "he may be excused for maintaining a somewhat skeptical attitude concerning the correctness of the diagnosis of these gentlemen who speak of making a certain diagnosis before the period of rupture."

The problem seems simple enough. Given pregnancy, and having ascertained that the ovum is not in the uterus, the diagnosis is effected. But we all know that the subjective symptoms of pregnancy are deceptive, and that the pigmentation, the mammary, and the utero-vaginal changes are not always so clearly defined in the first three months as to make it safe in every case to positively diagnosticate pregnancy in even the intra-uterine form. The advice to use the sound to demonstrate the vacuity of the uterus in suspected cases has been the cause of many needless abortions. Fortunately, the sound often does no other harm than to add to our sources of error. Twice within a year gravid patients have been sent to me with the assurance that the repeated introduction of the sound had shown the empty condition of the womb. In one of them, after an anæsthetic was given, it was easy to determine the presence of the head of the child through the cervix at the internal os; in the other I felt perplexed, and asked the opinion of Dr. Thomas. He pronounced it an ordinary pregnancy, and the event has shown that he was correct. Twice within a year, to my knowledge, the abdomen has been opened in this city for supposed extra-uterine gestation, and only ordinary gravidity was found.

In the main, our dependence must be upon local changes and local symptoms. Thus a tubal swelling and enlargement of the uterus, associated with suppression of the menses, often followed after a brief period by sero-sanguinolent discharges and increased flow at the menstrual period, with paroxysmal pains radiating from the side of the pelvis upon which the affected tube is situated, and with the expulsion of the uterine decidua at the end of the second or in the course of the third month, are to be regarded with suspicion. But a tubal sac is the product of a variety of pathological conditions.* The uterine changes in early months are inconstant. These sometimes correspond to those of ordinary uterine gestation, but often there is neither perceptible enlargement nor cervical softening to indicate pregnancy. Paroxysmal pains are frequent in other forms of tubal disease, and menstrual disturbances are common phenomena in uterine derangements. The

* Veit regards as an important distinction in the early stage, that whereas in other forms of tubal enlargement the swelling may be hard or tense or fluctuating, when due to an intact ovum it possesses a characteristic soft feel. Verhandlungen der Deutschen Gesellsch. f. Gynaek., Third Congress, Leipsic, 1890, p. 162.

expulsion of the decidua, though a valuable sign, is not of constant occurrence. In many tubal abortions the only symptoms are those of pelvic hæmatocele. In many instances of early rupture of the tube with hæmorrhage into the peritoneal cavity there are no antecedent symptoms, or only those of ordinary pregnancy. In reading the reported cases of the operative removal of pregnant tubes, it is surprising to note in how many of them the diagnosis was only established by the subsequent determination in the removed tubes of decidual cells and chorionic villi. Undoubtedly a probable diagnosis prior to rupture might be made in many instances if the patients could be subjected to frequent examinations from the beginning of the pregnant state, but this, in the nature of things, is rarely practicable.

In the intraligamentous form the conditions for diagnosis are more favorable. Here gestation is apt to be prolonged, and if rupture occurs between the folds of the broad ligament the hæmorrhage is limited in amount. In this class the patients are apt to seek early professional advice, owing to the discomforts from which they suffer. The swelling at the side of the uterus is easily reached through the vagina, and we have as distinctive signs a rapidly growing tumor, early fluctuation, and the presence of pulsating vessels over the site of the tumor. Bimanual examination under an anæsthetic, especially if the thumb be introduced into the vagina and two fingers into the rectum, makes it possible to determine that the tumor is independent of the uterus.*

After the third month it is not ordinarily difficult to determine the existence of the pregnant state. Ballottement is usually perceptible at an early date, and the fetal heart makes the diagnosis certain; but the greatest care needs to be exercised in the examination of the patient and in the formation of an opinion concerning the extra-uterine situation of the ovum. In a suspected case violence in the attempt to separate the tumor from the uterus may cause sac rupture. Grandin believes the absence of contractions when frictions are applied to the sac of an extra-uterine ovum should prove a most valuable aid to diagnosis. Küstner† curiously enough maintains that the existence of contractions in tubal pregnancy should distinguish them from other pelvic growths. Mr. Tait cites as a misleading condition an abnormal thinness of the uterine walls. In my own experience, lateral flexion of the uterus often simulates ectopic gestation to a surprising degree. In these cases the fundus containing the ovum lies upon one side of the pelvis. The cervix is crowded to the opposite side. Between the two

* According to Smolsky's observations, the tube in the first two months is the size of a pigeon's egg, at the end of the second month of an English walnut, at two and a half months of a hen's egg, at three months it reaches the size of the fist, and at four months the size of two fists. Variations may result from hydramnion, hæmato-salpinx, malformation, etc. Smolsky, Diagnostic et traitement de la grossesse tubaire, Neuvelles arch. d'obstet. et de gynécologie, Dec., 1890, p. 649.

† Müller's, Handbuch der Geburtshülfe, vol. ii, part 2, p. 541.

a deep sulcus is felt. If the patient is hysterical, these deranged relations are exaggerated by contraction of the abdominal muscles. No difficulty in detecting the error is experienced when the patient is anæsthetized, except in cases where the fundus is fixed to the side by adhesions. In two instances seen by me the intra-uterine nature of the pregnancy was only determined by the forcible introduction of the finger through the cervix. Cases of retroflexion of the gravid uterus with incarceration are likewise often difficult to distinguish from extra-uterine pregnancy.

The distinction by physical signs between the tubal, the ovarian, and the secondary abdominal form is scarcely practicable so long as trained anatomists fail to agree concerning them when the abdomen has been opened and the organs are exposed to view.

A review of the subject of diagnosis makes it apparent that many cases of ectopic pregnancy present no symptoms previous to rupture. In another class the existence of a suspicious tumor with few or none of the corroborative signs should lead to a waiting policy, or, when the symptoms are of a threatening character, to an explorative laparotomy. It is well, however, to remember that with reference to this latter procedure recent popular interest in abdominal surgery has a tendency to invest trifling anomalies occurring in gestation with a sinister importance. But there still remains a considerable class in which an early diagnosis can be reached with reasonable certainty.*

Treatment.—The treatment of extra-uterine fetation varies in accordance with the stage of pregnancy and the condition of the fœtus. For the sake of convenience, we distinguish—1. Cases of early gestation; 2. Cases of advanced gestation (fœtus living); 3. Cases of gestation prolonged after the death of the fœtus.

1. *Cases of Early Gestation.*—The indication for treatment in the early months varies with the conditions. If rupture has occurred, care should be employed to ascertain, if possible, whether the resulting hæmorrhage has taken place between the folds of the broad ligament, or, if intraperitoneal, whether the blood is free in the abdominal cavity, or is restricted to the pelvis by old adhesions. Circumscribed effusions of blood due to ruptured tubes do not, as a rule, threaten life, and disappear with time and with little other treatment than rest in the recumbent posture.

If the outpouring of blood has taken place primarily into the abdominal cavity, or as a secondary occurrence after the giving way of the first barriers, laparotomy is unquestionably demanded. While it is not denied that even in these extreme cases the effused blood may be circumscribed by an adhesive inflammatory process, and that a few patients may recover with an expectant treatment, the waiting policy is

* Hawley reported in the N. Y. Med. Jour., June 16, 1888, a case where the diagnosis made previous to rupture was confirmed by laparotomy.

a gamble with life. On the other hand, the opening of the abdomen for the purpose of removing blood and clots, and for the extirpation of the tube-sac has been the means, since Mr. Tait demonstrated the practicability of the operation, of saving multitudes of women from impending death. The operation is not, as a rule, difficult. It involves the separation of adhesions where these exist, the tying of the pedicle, and the removal of the ruptured sac. In the intraligamentous form it may be necessary to ligate the attached portion in sections. Where a pedicle can not be readily prepared, Veit recommends the tying of the broad ligaments at the two extremities of the sac before proceeding to ligate the base. Previous to closing the abdominal incision great care should be taken to insure the arrest of hæmorrhage not only from the stump but from the separated adhesions.

When the diagnosis is made previous to rupture the choice lies between laparotomy and the employment of measures to destroy the life of the embryo. In practice the decision is pretty certain to be governed by other than theoretical considerations. Thus an experienced operator, who possesses trained assistants and can command for his patient the surroundings which are needful for success, will be apt to select laparotomy. The risks have been proved to be small, and the patient is relieved from possible future troubles due to retention of the products of conception. But all men are not experts in pelvic surgery. The danger which threatens the life of the patient is often imminent, and assistance from afar is not always easy to obtain. Under these conditions the indication for treatment is plainly the adoption of measures to destroy the life of the fœtus, and thus, by arresting the growth of the ovum, to diminish the chances of rupture and of hæmorrhage.

The methods which have heretofore been employed to destroy the ovum are puncture of the sac, injections of morphia solutions, elytrotomy, and the faradic current.

Puncture of the Sac.—Puncture of the sac is usually easily effected by the introduction of an exploring trocar through either the vaginal or rectal wall. The operation is to be recommended on the score of simplicity, but has not been attended with very brilliant results. Recoveries after puncture have been recorded by Greenhalgh, Tanner, Stoltz, Jacobi, Kœberlé, and E. Martin (two cases). Fatal issues from septicæmia and peritonitis followed puncture in the hands of Routh, J. Y. Simpson, A. Simpson, Martin, Braxton Hicks, Thomas (two cases), Conrad, Netzel, Hutchinson, John Scott, Gallard, and Depaul. Fränkel* withdrew nearly three fifths of an ounce of amniotic fluid from the sac without interrupting the course of pregnancy.

* Fränkel, Zur Diagnostik und operative Behandlung der Tubenschwangerschaft, Arch. f. Gynaek., Bd. xiv, p. 197.

Injections of Solutions into the Sac, designed to destroy the Fœtus —This method was first suggested by Joulin.* He proposed injections of sulphate of atropia (one fifth of a grain dissolved in a few drops of water) into the sac by means of a long hypodermic syringe. His suggestion subsequently was successfully carried into effect in two cases by Friedreich,† of Heidelberg. The needle of the syringe, he advised, should be introduced into the sac through the abdominal or vaginal walls, a few drops of fluid should then be withdrawn, and its place supplied by the solution containing the poison selected. Friedreich employed by preference a fifth of a grain of morphia. The operation was repeated every second day, until the diminished size of the ovum afforded evidence that the result sought for had been accomplished. The operation seemed to produce but slight inflammatory disturbance, and the maternal system did not feel the influence of the narcotic. Rennert‡ has since succeeded in destroying the life of the fœtus in the fifth month of extra-uterine gestation by means of a single injection containing about half a grain of morphia. The patient recovered after a protracted illness. Kœberlé reported to the Gynæcological Section of the Eighth International Medical Congress at Copenhagen a case of advanced abdominal pregnancy where the child was destroyed by morphia injections. The fœtus and placenta were absorbed. The recovery was complete. Six cases have been reported by Winckel, and one by Fournier. Of the eleven cases, three died.

The Faradic and Galvanic Currents.—The transmission of the faradic current through the ovum has proved a safe and efficient method for destroying the life of the fœtus during the first three months of its existence. The application consists in passing one pole into the rectum to the site of the ovum, and pressing the other upon a point in the abdominal wall situated two to three inches above Poupart's ligament. The full force of the current of an ordinary one-cell battery should be employed for a period varying from five to ten minutes. The treatment should be continued daily for one or two weeks, until the shrinkage of the tumor leaves no doubt as to the death of the fœtus.

The successful employment of the faradic current in extra-uterine pregnancy we owe to Dr. J. G. Allen, who reported two cases of recovery through its instrumentality in 1872. His first case occurred in 1869, the second in 1871. Previously, in 1859, Burci had succeeded in shriveling up the ovum, in a case of tubal pregnancy, with the

* Joulin, Traité complet des accouchements, p. 968.

† Cohnstein, Beitrag zur Schwangerschaft ausserhalb der Gebärmutter, Arch. f. Gynæk., Bd. xiv, p. 355. Hennig reports likewise a case operated on by Kœberlé, where profuse hæmorrhage occurred. It is not stated whether the patient recovered. (Die Krankheiten der Eileiter und die Tubenschwangerschaft, p. 138.)

‡ Rennert, Extrauterinschwangerschaft im fünften Monate, Arch. f. Gynæk., vol. xxiv, p. 266.

galvanic current transmitted through the tumor by means of two acupuncture needles. In 1866 Dr. Braxton Hicks tried the faradic current, but abandoned it after the second application. Dr. Allen was apparently in no haste to report his triumphs, but appears to have mentioned them incidentally in the course of a discussion before the Obstetrical Society of Philadelphia. So little pains did he take regarding his discovery that the subject was nearly forgotten, until a new success was reported by Drs. Lovering and Landis, of the Starling Medical College, in 1877. Since then, Brothers* has collected fifty cases in which electricity was employed. In twenty-five cases, to which I can add a twenty-sixth from my own practice, and not included in Brothers's list, the health of-the patient was ascertained to be good at the end of periods varying from one to eight years.

There were no evil results in any of the cases traceable to the electricity. Of the four fatal ones, in that of Janvrin rupture of the tube had undoubtedly taken place before the galvanism was employed; in that of Wylie the eight months' fœtus was killed by injections of morphia into the sac after electricity had been discarded; and in the cases of Duncan and Steavensen and Boulton and Steavensen electro-puncture was employed,

Against the method, it has been urged that the successes reported are in themselves evidences of an erroneous diagnosis, that the faradic or galvanic current endangers the integrity of the tube, and that the ovum, after its vitality has been destroyed, is liable to produce suppuration. But *a priori* deductions should not be allowed to outweigh the evidence of carefully conducted experiments. It should be borne in mind, however, that electricity is only available in the first three months, and that no one in this country advocates electro-puncture.†

Cases of Advanced Gestation.—After the third month it has now come to be regarded as a settled rule that the removal of the fœtus, the placenta, and the investing membranes should be attempted as soon as the diagnosis has been made. If complete extirpation of the sac proves impracticable, it should be removed to the fullest extent possible, as its presence when left *in situ* is capable of leading to intractable sinuses and persistent suppuration. The older method of stitching the sac to the abdominal wall and leaving the placenta to come away spontaneously, furnished a certain number of favorable re-

* A. Brothers, Subsequent Behavior of Cases of Extra-uterine Pregnancy treated by Electricity, American Jour. Obstet., vol. xxiii, No. 2, 1890.

† Dr. Franklin H. Martin (*vide* Goelet's Archives of Gynæcology, 1891, p. 100) has sought to show, by experiments on incubating hen's eggs, that the faradic current is relatively worthless as a feticide agent, and recommends the substitution in all cases of the galvanic current. If this should be established with regard to the human ovum, it must be confessed it would greatly weaken, if not destroy, the argument in favor of electric treatment, since nearly all the reported successes have been obtained by faradism.

sults after the death of the child and the arrest of the circulation had taken place. During the life of the child death from hæmorrhage was the nearly uniform result. The conclusion drawn from this experience was to await the death of the fœtus before operating, thus exposing the woman to the manifold dangers arising from the presence in the peritoneal cavity of a growing ovum, or of a sac containing dead matter, often in a state of putrefaction.

But with clearer anatomical views of extra-uterine pregnancy, it is getting more and more to be recognized that the treatment of that condition is subject to the ordinary rules of abdominal surgery.

The difficulties encountered in the removal of the fetal sac are the result of excessive vascularity and extensive adhesions, but these obstacles to success have of late been found in many cases not to be insuperable. In the purely tubal form, where advanced gestation is reached without rupture, the uterine end forms a pedicle which permits the employment of the ligature *en masse*. In this category should be placed the case of Olshausen, and probably that of Eastman. In an intraligamentous case, Breisky first stitched the sac to the abdominal wound and removed the fœtus. He then removed the stitches, ligated the broad ligament on the side of the uterus, and separated the tumor, tying at the same time any large vessels found bleeding on the cut surface. By progressive ligation of the base from within outward toward the pelvic walls, the sac with the contained placenta was detached with but slight loss of blood. A portion of the sac which had grown into the meso-cæcum was enucleated. Packing with iodoform gauze was subsequently resorted to.

Schauta* has recently reported a method in the intraligamentous form which promises important future results. The ovum and uterus apparently constituted a single growth. It was impossible to ligate between them. He succeeded, however, in applying a double ligature to a peritoneal fold, which formed the residue of the ligamentum infundibulo-pelvicum. After dividing between the ligatures he got underneath the peritonæum, which he severed by a circular line to the right uterine cornu. The peritonæum was then dissected away from the sac wall without noticeable hæmorrhage, and the six months' ovum was enucleated entire. Upon detaching the ovum from the uterine wall there was considerable bleeding, requiring the provisional employment of compression and the subsequent use of the suture. The peritoneal sac was then attached to the wound, and drained by Mikulicz's method.

In these four cases, all of which ended in recovery, success was due to the complete extirpation of the sac. Werth† reported in 1889, to

* Schauta, Beiträge zur Casuistik, Prognose und Therapie der Extrauterinschwangerschaft, Prag, 1891.

† Werth, Behandlung der Extrauterinschwangerschaft, Verhandlungen der

the Third Congress of the German Gynæcological Society, nine operations between 1887 and 1889. The case of Schauta increases the list to ten. Of these, eight recovered and two died. It was not possible to remove the entire sac in every case, but even partial extirpation, with employment of ligatures to the placental vessels and removal of the placenta, has been found to lessen the risks of the operation and to shorten the period of convalescence.

After the death of the fœtus the same principles hold good so long as the sac contents have not been infected. After putrefaction or pus formation has set in the older method of stitching the sac to the abdominal incision previous to opening it is still the best. After the removal of the fœtus the placenta should be left to separate spontaneously. While the detachment is taking place, it has been found that a mixture of tannin and salicylic acid strewed upon the inner surface of the sac is useful as a styptic and a disinfectant.

Deutschen Gesellschaft für Gynaekologie, 3te Kongress, p. 175. Other successful cases were reported by Braun, Olshausen, John Williams, Lazarewitsch, and Treub. Fatal cases occurred in the practice of Prochownik and L. Braun.

OBSTETRIC SURGERY.

CHAPTER XVIII.

THE INDUCTION OF PREMATURE LABOR.

Induction of premature labor.—Indications.—Contracted pelvis.—Habitual death of fœtus.—Diseases which imperil the life of the mother.—Operation.—Catheterisatio uteri.—Intra-uterine injections.—Rupture of membranes.—Mechanical dilatation of cervix.—Vaginal douches.—Tampon.—Choice of methods.—Care of the child.—Artificial abortion.

The induction of premature labor is indicated in cases in which the continuance of pregnancy, or delivery at full term, is associated with risks to mother or child, or to both, which may be diminished by bringing pregnancy to a close at an early period after the fœtus is prepared for extra-uterine existence. The time at which the latter begins is usually placed at the twenty-ninth week. As, however, the preservation of the child at so early a date is an exceptional occurrence, and as a large proportion of those which by tender care are made to survive the first danger of immaturity perish in infancy, commonly falling a prey to hydrocephalus or to intestinal derangements, the interests of the child call for the postponement of the operation as long as practicable. Where the choice lies with the physician, the provocation of labor is usually deferred until the thirty-third or thirty-fourth week. The principal indications are:

1. *Moderate Degrees of Pelvic Contraction.*—In flattened pelves measuring from two and three fourths to three and one fourth inches, and in equally contracted pelves under three and one half inches, the passage of a full-term child is not impossible, though usually difficult and dangerous. By inducing premature labor, however, owing to the smaller size of the fœtus, and especially to the increased compressibility of the fetal head, we are enabled to diminish the mechanical obstacles to delivery, and thus to improve the prognosis for both mother and child. To the mother the advantage from the operation is in all cases decided, while to the child not much is gained in the extreme degrees of contraction.

The time at which gestation should be interrupted depends upon the size of the pelvis and our estimate of the size of the fetal head. The distance from the lower border of the symphysis to the promon-

tory should be accurately measured, and the side walls of the pelvis carefully explored. Schroeder's measurements show that the biparietal diameter of the head is, between the twenty-eighth and thirty-second week, about three and one fourth inches; between the thirty-second and thirty-sixth week, nearly three and a half inches; and that after the thirty-sixth week the increase is insignificant.*

One of the most important questions to be decided in reference to the induction of labor is the period to which gestation has advanced. But this, in the absence of well-defined signs, it is easy to miscalculate. Physicians have been misled by the large size of the uterus in twin pregnancies and hydramnion into provoking labor before extra-uterine existence was possible.

Ahlfeld has shown that the long axis of the fœtus, when flexed *in utero*, is almost exactly one half its entire length in an extended position. He proposes measuring the former with a Baudelocque pelvimeter, by placing one extremity *per vaginam* upon the child's head, and the other upon a point in the abdominal walls over the fundus of the uterus at which the breech of the child is felt. Very nearly the same results were obtained by measuring from the upper border of the symphysis in place of passing the lower branch through the genital canal. The following arrangement, based upon his tables, places before us in a practical way the result of his investigations, so far as they apply to the questions involved in the induction of premature labor: †

2. *Habitual Death of the Fœtus.*—It has been proposed that, when in successive pregnancies the fœtus perishes *in utero* during the latter weeks of gestation, labor should be induced after the period of viability has been reached, but before the time at which, according to previous experience, the fatal ending was to be expected. This plan of treatment does not apply to cases where death is due to syphilis, as a better

* Schroeder, Lehrbuch der Geburtshülfe, 4te Aufl., p. 235. It is to be remembered that the biparietal diameter is capable of a considerable degree of compression, and that it is usually the bitemporal rather than biparietal diameter which has to pass the narrowest diameter of the pelvis.

† The arrangement is modified from one furnished by Stahl (Geburtshülfliche Operationslehre, p. 47). Owing to individual differences in the length of the fœtus at the same period of gestation, a considerable source of error inheres to the Ahlfeld method of computation. It is, however, much less than those to which estimates based upon the size of the uterus are subject.

Axis of fœtus.	Length of fœtus.	Biparietal diameter.	Duration of pregnancy.
Inches.	Inches.	Inches.	Weeks.
10	20	$3\frac{1}{2}$	38–40
$9\frac{1}{2}$	19	$3\frac{1}{8}$	35–37
9	18	$3\frac{1}{4}$	31–34
8	16	3	29–30

result is to be expected by subjecting both parents in advance to anti-syphilitic treatment. Little benefit, too, would be derived from premature labor where the death is due to organic diseases of the fœtus. But where death is the result of inanition, dependent upon maternal anæmia, degenerative changes or faulty development of the placenta, or alterations of the umbilical cord, the operation is fully justifiable. With the difficulty, however, of making the diagnosis and fixing the time when labor should be induced, there have been but few cases in which the procedure has furnished favorable results.

3. *Diseases which imperil the Life of the Mother.*—In these cases the operation is primarily performed in the interests of the mother, and is indicated, therefore, even when the child is known to have perished. Sometimes, however, premature labor becomes a means of saving the life of the child, which shares the dangers that threaten the maternal existence. In this category belong especially chronic affections of the heart and of the respiratory organs; enormous distention of the abdomen from multiple pregnancy, hydramnion, tumors, and ascites, which occasion extreme dyspnœa; pernicious anæmia; uncontrollable vomiting; hæmorrhages from placenta prævia; chorea; convulsions; and nephritis, associated with excessive œdema. In each case, however, it is incumbent to carefully consider whether the special condition is rendered more threatening by the existence of pregnancy, and to weigh the question as to how far, for the time being, the dangers are likely to be increased by the progress of labor.

Stehberger has proposed extending this indication to cases where the preservation of the mother's life is hopeless, but in which premature delivery affords a chance of saving the life of the child.*

Operation.

A great number of methods have been proposed with a view to provoke labor prematurely. Most of them, however, such as the administration of ergot, of quinine, or of jaborandi, the stimulation of the vagina with carbonic acid, frictions of the breasts, and the like, do not require anything more than cursory mention. The following procedures alone possess any special claims to favor:

Catheterization of the Uterus.—This method consists in the introduction of a catheter, or, better still, an elastic bougie, between the membranes and the walls of the uterus, and leaving the instrument *in situ* until active labor sets in. In performing the operation it is a good plan to place the patient in a recumbent posture upon a hard table, with the hips brought near the edge, and the thighs well fixed upon the body. After preliminary vaginal disinfection, two fingers guide the point of the bougie into the cervix, the index-finger, passed to the os in-

* Stehberger, Lex regia und künstliche Frühgeburt, Arch. f. Gynaek., Bd. i, p. 465.

ternum, then follows the instrument, and as it enters the uterus directs it to one side to prevent it from rupturing the membranes. In the case of primiparæ, preliminary dilatation of the cervix may be secured, if necessary, by the use of a sponge-tent or of the vaginal douche. The bougie should be pushed slowly upward with the disengaged hand and allowed to follow its own course, between the membranes and the uterus. To prevent the instrument from slipping down, two inches of the extremity may be left outside the cervix to find support against the vaginal wall. A retentive tampon is rarely necessary.

The method is tolerably certain. In favorable cases labor follows its employment in the course of a few hours. As a rule, the response is more prompt in multiparæ than in primiparæ. Sometimes, however, no action is set up during the first forty-eight hours, or the pains excited are of a cramp-like character. In either case it is well to resort to other additional measures. Outside of unwholesome hospitals, the use of the catheter or bougie to excite labor is not associated with any peculiar risks. The danger of detaching the placenta is not imminent, if the instrument be introduced slowly, as, owing to its elasticity, the bougie tends to make its way around the placental margin. In maternity hospitals, however, it may serve as a point of entry for miasmatic poisons, and thus be followed by local irritation and puerperal septic affections. Because of this danger the solid bougie is preferable to the hollow catheter. In all cases only a perfectly clean and new instrument should be used.

Injections between the Uterus and Ovum.—Cohen, of Hamburg, proposed in 1848 the separation of the membranes by injecting tar-water through a long-nozzled syringe made to penetrate about two inches within the uterine cavity. The nozzle was furnished with a rounded extremity, and with openings upon the side. He recommended that the injection should be continued until a distinct feeling of distention was experienced by the patient, which sometimes required the employment of nearly a quart of the fluid (720 grammes).* This plan has since been modified by the substitution of an elastic catheter for the metallic tube, and by the injection of a few ounces of simple warm water (98° Fahr.) in place of the aqua picea. In case of failure with a single injection, it has been recommended to repeat the procedure. Professor Lazarewitch has demonstrated that the nearer the irritation is carried to the fundus the more certain and speedy the result. He therefore employs a syringe with a central opening, and passes it as near to the fundus as possible.†

When efficiently performed, the method possesses the advantage of rapidly exciting uterine labor-pains. Künne reports fifteen cases in which he resorted to it with complete success. He cautions against

* Cohen, Neue Ztschr. f. Geburtsk., Bd. xxi, p. 116.

† Lazarewitch, Trans. of the Obstet. Soc. of London, 1868.

using force in injecting, and recommends, as a means of avoiding the passage of air into veins, the withdrawal of the catheter, and its reintroduction, in case a hæmorrhage should betoken that the placenta had been impinged upon. Others have employed the method many times with entire impunity. Still, cases of sudden death have occurred during its use, which have been referred to shock, to air getting into the uterine sinuses, and to rupture of the uterus. While, perhaps, the general results from uterine injections have not been less satisfactory than from the employment of other measures for inducing premature labor, the suddenness of death in the fatal cases has had a deterrent effect upon its extended employment.

Rupture of the Membranes.—This is the oldest of all the methods now in use. It is best performed by means of a simple apparatus devised by the Freiherr Braun von Fernwald, consisting of a goose-quill sharpened like a pen and nicked upon its convex surface for the passage of a uterine sound. Thus mounted, with its point guarded by the sound, it can be introduced, without risk to the maternal tissues, through the cervix to the ovum. Then, by simply pushing the quill upward, the point is made to clear the sound and effect the puncture of the membranes. The method is certain, though not always speedy in its action. It is open to the objections which hold good in all cases of premature discharge of the amniotic fluid. Hopkins recommended, as a mode to provide for the gradual escape of the liquor amnii, tapping the membranes with a sound at a distance from the os internum. Rokitansky has shown, from the statistics of Braun's clinic, that in hospital practice puncture of the membranes is the safest means of inducing premature labor, diminishing as it does the chances of infection, which is the chief source of danger in all the measures where the irritation is applied directly to the inner surface of the uterus. Though in private practice I have never from choice selected this method, I have witnessed many cases in which the membranes have ruptured accidentally, and yet have failed to notice, either in the case of the mother or child, the serious consequences which theory would lead us to apprehend. It is not adapted for the higher degrees of pelvic contraction or for cases where speedy delivery is desirable.

Mechanical Dilatation of the Cervix.—The dilatation of the cervix with sponge-tents or laminaria is rarely resorted to, except as preparatory to other measures. While the expansion of the tent softens the cervix and excites uterine contraction, the effect is frequently transient. To be sure, the action may be kept up by a succession of tents gradually increasing in size, but such a plan denudes the cervix of its epithelium, and is apt to lead to septic infection.

The Barnes dilator is a most efficient aid in cases of induced labor. It should be surgically clean, and before its introduction both vagina and cervix should be thoroughly disinfected. I have found it conven-

ient to seize it, properly folded, with a pair of dressing forceps, by means of which it can be passed into the cervical canal. I then withdraw the forceps, and push the dilator upward with two fingers. The dilator is, as Barnes has termed it, a water-bag. It should never be distended with air, as rupture of the bag in that case might be speedily followed by the death of the patient. As for the introduction of the smallest-sized bag the cervix requires to be sufficiently expanded to permit the passage of at least two fingers, it is useful chiefly as an adjuvant to other plans of treatment. At first the dilatation should only be carried to the extent necessary to render the cervix tense. When labor has fairly begun, the fluid pressure of the dilator upon the cervix serves to strengthen the uterine action. When left *in situ*, the instrument insures the development of good pains. It should, however, be removed from time to time, if not forcibly expelled into the vagina, and carbolized injections should be employed to prevent infection. So soon as the physiological softening of the cervix which results from labor has been effected, rapid dilatation can be advantageously employed. When the cervix is rigid, the rubber bag is only useful as a reflex exciter of pains. To be sure, the rigid cervix can be forcibly dilated to almost any extent by hydrostatic pressure, but, as a rule, it closes down to its original dimensions so soon as the pressure is removed. In rare cases forcible dilatation may lead to cervical laceration.

Tarnier has devised a bag which can be passed upward through the cervix and distended in the lower uterine segment. It serves to partially detach the membranes, and excites by its presence active uterine efforts. Its liability to rupture is the most serious objection to its employment.

The Vaginal Douche.—The vaginal douche was introduced into practice by Kiwisch, in 1846. It consists in directing a stream of tepid water with considerable force directly against the cervix. The stream may either be furnished by a Davidson's syringe, or a continuous current from a tube connecting with a vessel placed at an elevation above the patient may be used. The latter is the safer method. The large-sized fountain-syringe, made to hold a gallon of water, is a very convenient apparatus. The duration of each injection should be from ten to fifteen minutes. At the outset, three douches in the twenty-four hours suffice. Subsequently the frequency and duration should depend upon the degree of action excited and the urgency which exists for bringing labor to a close. Twelve are about the average number of injections required. In pressing cases they have been repeated as often as once in three to four hours. The temperature of the water employed should be about 106° Fahr.

In using the douche the patient should be placed across the bed, and an India-rubber sheet should be so arranged under the hips as to convey the water as it escapes from the vulva into a vessel beneath.

Every care should be taken to avoid the introduction of air into the vagina, and at the beginning of each douche precautions should be adopted to facilitate the escape of the fluid. The forcible pressure of the stream has been known to drive air contained in the vagina into the cervix. The same accident has followed imperfection in the valves of the syringe.

The douche acts by the warmth of the water, by stimulation of the lower uterine segment, and by dilatation of the vagina. After the douche has been continued for a time, the latter is sometimes distended so as to be nearly in contact with the pelvic walls.

The vaginal douche as a means of inducing labor has of late years fallen somewhat into disrepute. Its chief recommendation was the supposed harmlessness of the procedure—a precious quality, to which in reality it appears, however, to possess little claim. Numerous cases have been reported where death has followed the accidental introduction of air, and sharp peritoneal symptoms, according to Kleinwächter,* have been known to result from the excessive distention of the vagina. The dangers referable to the latter cause increase with the repetitions of the douche. It is likewise claimed that its repetition tends to lessen the efficiency of the uterine contractions. At present its employment is generally restricted to the preliminary dilatation of the os, or to the sustaining of the action of other measures.

The Vaginal Tampon.—Braun introduced an India-rubber bag, furnished with a tube and a metal stop-cock, which, under the name of the *colpeurynter*, still plays a considerable *rôle* in obstetrical practice in Germany. When filled with water in the vagina, it formed a painful and rather uncertain mode of inducing labor. It is now rarely employed except in hæmorrhage, and where it is desired to prevent premature rupture of the membranes. Care should be taken to only moderately distend the vagina, and not to continue the pressure for any lengthened period of time.

Galvanization.—Bayer† urges the constant current as an available means of exciting labor-pains. He recommends placing the negative pole of a suitably constructed electrode in the cervix, and the positive pole upon the abdomen near the fundus. Ten to sixteen elements should be used for a period varying from ten to twenty minutes. The advantages claimed for galvanism are, that it excites true pains, that it does not produce strictures, that it causes the cervix to soften and dilate naturally, and that by its use the dangers of infection are lessened. The chief drawback consists in the necessity for frequent repetitions of the procedure before labor is brought to a close. Thus, in the six cases where it was used by him, from two to thirteen appli-

* Kleinwächter, Prager Vierteljahrsschrift, 1872, Heft i, p. 56.

† Bayer, Ueber die Bedeutung der Electricität in der Geburtsh. und Gynaek., vol. xi, p. 89.

cations were made, and the time from the first application to the birth of the child varied from two to eleven days. As the effect of the first application is to soften the cervix and render it dilatable, galvanism may in the future find its place as a substitute for tents, or the vaginal douche, in the preparation of the lower uterine segment for the employment of accelerative measures.

Choice of Methods.—From the foregoing it will be seen that no one of the different proceedings mentioned is entirely free from objection. Aside, however, from infection—a danger more especially dreaded in maternity hospitals—and the avoidable accident of driving air into the veins, the most serious difficulties against which we have to contend arise from the tardy dilatation of the os and the prolongation of labor. Any of the methods are good if only they act speedily. It is advisable, therefore, in practice to follow the excellent advice of Dr. Barnes, and divide the induction of premature labor into two stages, in the first of which provocative, and in the second of which accelerative, measures should be adopted. In the former category should be placed the dilatation of the cervix with tents, the vaginal douche, and the catheterization of the uterus; in the latter, dilatation of the cervix with the rubber bags, rupture of the membranes, and, in case of delay, delivery with forceps or by version.

The plan I have generally followed consists in beginning in the afternoon with the vaginal douche, and following with the introduction of a solid bougie, to be left in the uterus overnight. In many cases labor is excited in the course of a few hours. In the morning, if the process is delayed, the vaginal douche is repeated. There are few cases in which, toward the end of the twenty-four hours, the cervix is not found softened and well lubricated with mucus. The dilators should then be employed, the operator taking his time, as permanent dilatation is the object sought after. If the membranes come down well, the dilator may be removed and the progress of the case left to Nature. Often it is advisable to adopt the plan of Dr. Barnes, rupturing the membranes when the cervix will admit three or four fingers, and then dilating with the large-sized bag until the uterus is opened fully for the passage of the child. Finally, according to the conditions present, the physician may either await the termination of the labor, or deliver by version or by lightly constructed forceps.

Care of the Child.—Premature infants possess slight powers of resisting external agencies. The customary baths should possess a temperature of 100° Fahr., or very nearly that of the amniotic fluid. The chances of raising premature infants are greatly enhanced by feeding them with mother's milk. The artificial maintenance of the body-heat is essential to the preservation of life in the early period of extra-uterine existence. In a rude way this may be accomplished by placing the child in warm cotton near the fire. Before the thirty-second week

the result in such cases depends almost entirely upon the unremitting watchfulness and zeal of a devoted mother or nurse. Much better results are, however, obtainable through the agency of the contrivances of Credé and of Tarnier.

Credé's * apparatus possesses the advantage of cheapness and simplicity. It consists of a tub made of copper with double walls and floor. The compartment between the walls is capable of containing thirty-five pints of water. For convenience in filling the compart-

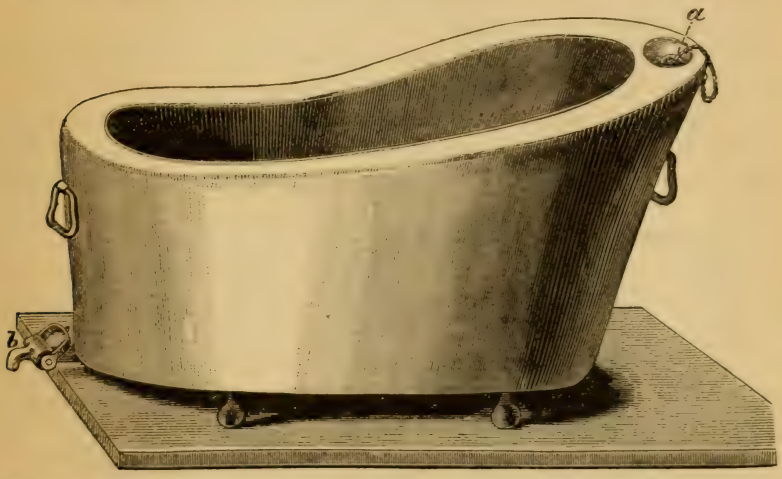


FIG. 142.—Credé's apparatus for the maintenance of the body-heat of premature and feeble infants.

ment, a funnel-shaped depression, provided with a stopper, is furnished in the upper margin. A stop-cock below, at the opposite end, permits the water to be withdrawn at will. In this vessel the child is placed, enveloped in fine cotton or soft flannel. The coverings should reach to the brim of the vessel, the face of the child alone remaining exposed. Every four hours the space between the walls is to be filled with water heated to 122° Fahr. When the water is first introduced, the temperature within the tub is about 107½°. In the last two hours it sinks to about 99½°. In extreme degrees of prematurity, a more equable temperature may be maintained by partially refilling every hour or every half-hour. The child is to be disturbed as little as possible. It should be removed only to be bathed and to be placed to the breast. The napkins should be changed, as far as possible, within the vessel.

Credé's * apparatus has been employed in the Leipsic Maternity for

* CREDÉ, Ueber Erwärmungsgeräthe für frühgeborene und schwächliche, kleine Kinder, Arch. f. Gynæk., vol. xxiv, p. 128, Berlin, 1884. The precise measurements of Credé's apparatus are as follows: Length outside, above, 39 inches, below, 25 inches; inside, above, 23½ inches, below, 21½ inches. Width outside, above, 19 inches, inside, 15 inches; inside, above, 15 inches, below, 11 inches.

a period of twenty years. The total number of children thus treated amounted to six hundred and seventy-eight. The weight of these children, with few exceptions, was less than five and a quarter pounds. The total mortality was eighteen per cent. Of twenty-four children weighing between two and three pounds, twenty died; of one hundred and fifteen children weighing between three and four pounds, forty-two died; of four hundred and seventy-six children weighing between four and five pounds, fifty-four died; while of fifty-two children weighing between five and six pounds (seventeen twins), but one died.

The incubator of Tarnier was first used at the Maternité, in 1881, for the rearing of prematurely born children. It consists of a wooden box with walls 0·10 to 0·12 centimetre thick, filled in with sawdust to prevent loss of heat. A central partition divides the box into two compartments, the one for hot water, the other for the infant's cradle.

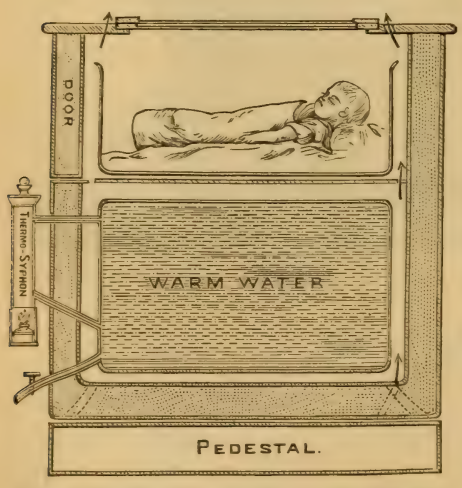


Fig. 143.—Section of hospital incubator. (Tarnier.)

A metal case, of a capacity of about seventy-one litres, fits into the lower compartment, leaving a space of two to three centimetres between its walls and those of the box for the free circulation of air from below upward. The capacity of the upper compartment is about eighty-six cubic centimetres; there is free circulation of air between it and the lower compartment, and it is in communication with the outer air by means of two openings—the one, on its upper surface, shut in by a double plate of glass, the other, laterally, opening like a door, and allowing exit to the cradle. In each corner of this upper compartment is a hole for the escape of the heated air from below. To the lower compartment, containing the hot water, is attached a thermo-siphon by an upper and a lower tube. When the lamp under this siphon is lighted, the heated water flows through the upper tube into the chamber, displacing an equal amount of water which flows back to the siphon. Thus a current is established, the temperature of which can be raised to the desired point. In cold weather it has been found necessary to light the lamp three times daily, allowing it to burn each time about two hours. The lamp should be extinguished when the temperature in the upper compartment is about two degrees above the heat

desired. The registering thermometer may be laid alongside the infant.*

In general, a mean temperature of 86° Fahr. is sufficient, but 96° is borne without harm. The children should be clothed in the usual manner. The napkins should be changed five to six times daily. A daily bath should be given. Children sufficiently developed to suckle should be placed to the breast. Those too feeble to nurse are fed in Paris upon asses' milk. The result of two years' trial of the incubator at the Paris Maternité Auvard reports as follows: Of ninety-three healthy premature children, thirty-one died; of fifty-eight premature children with complicating diseases, fifteen died. In comparing these results, however, with those reported by Credé, it is necessary to note that at the Maternité, in Tarnier's service, only children weighing four pounds and less were placed in the incubator, while the limit in the Leipsic Maternity was in general five and a quarter pounds.

Artificial Abortion.

Artificial abortion is justifiable whenever it offers the only hope of saving the life of the mother. The morality of this general proposition is unquestioned. It is not, however, by any means easy to determine in a specified case whether the conditions which render the induction of abortion a duty really exist.

The principal recognized causes for the operation which admit of little dispute are: 1. Incarceration of the prolapsed or retroflexed uterus when the dislocated organ can not be replaced. 2. Diseases of pregnancy which immediately imperil life, and which have been vainly combated by all the resources at our disposal. Of these diseases the most prominent is uncontrollable vomiting. Exceptionally, the indication may arise in affections of the heart, lungs, and kidneys, where the symptoms are acute and peculiarly threatening.

The justifiability of abortion is, however, by no means so clear when the danger to the mother first arises after labor has actually begun. This is especially the case in extreme degrees of pelvic contraction, or where the presence of large tumors renders the parturient canal impassable, as in these cases, by means of the Cæsarean section, there is always a probability of saving the life of the child, with a fair prospect of preserving the existence of the mother. It is considered right, under such circumstances, after a dispassionate and colorless statement of the facts, to leave the decision to the mother and the friends more immediately interested. When the operation is performed for contracted pelvis, the following figures will show at how late a period it may be undertaken:

* Auvard, De la couveuse pour enfants, Arch. de Tocologie, October, 1883, p. 577. The account given above is copied from abstract furnished to the Am. Jour. of Obstet., April, 1884, by Robert H. Grandin.

Antero-posterior diameter of pelvis.	Latest period for inducing abortion.
1½ inch.	Beginning of sixth month.
1¼ inch.	Beginning of fifth month.
1 inch.	Four months and a half.

With less than an inch the difficulties of inducing abortion increase to such a degree as to make the operation rarely advisable, or indeed even practicable.*

The induction of abortion is accomplished by puncturing the membranes with a uterine sound, or by dilatation of the cervix with a sponge- or a tupelo-tent. In the early months dilatation by means of a tent possesses the advantage of promoting the expulsion of the ovum entire. In the sixth and seventh months the same means are available that have been described in connection with the induction of premature labor.

Preparation of Aseptic Sponges for Obstetrical Purposes.—The sponges employed should be of the finest quality. They should be pounded with a wooden mallet until the cretaceous particles can no longer be felt, then washed for ten minutes in a two-per-cent solution of permanganate of potash, and washed and kneaded thereafter in a two-per-cent solution of bioxalate of potash, till they become of a yellowish-white color, and no more sediment remains in the solution. To remove the oxalic acid, they should be washed in distilled water until no reaction is produced with lime-water. The sponges, in this way freed of inorganic matter, should be allowed to soak two days in a five-per-cent solution of carbolic acid. The carbolized sponges are to be pressed out two or three times in a ten-per-cent solution of gum arabic. A knitting needle is passed into the sponge and a carbolized thread employed to compress it into a cylindrical shape, care being taken not to give the sponge a spiral turn in the winding. Then withdraw the needle, wrap in tissue paper, and leave the sponge to dry. The drying usually requires three or four days. Finally, remove the silk, file away rough portions, and place in metal box for future use. (Method of Jungbluth, *vide* Zur Behandlung der Placenta Praevia, Volkmannsche Sammlung, No. 235.)

As to the choice of time when the operation should be performed, opinions differ. Some prefer the first two months, on account of the small size of the ovum and the slight development of the fetal tufts at the decidua serotina. Most physicians wait till the first three or four months have expired, as the diagnosis of pregnancy is then certain, the execution of the operation easy, and the detachment and expulsion of the fetal appendages more complete.

* De Soyre, Dans quels cas este-il indiqué de provoquer l'avortement? Paris, 1875, p. 68.

CHAPTER XIX.

FORCEPS.

History.—Varieties of forceps; short forceps; long forceps.—Action of forceps.—Indications.—Preperations.—Forceps at outlet.—Operation; introduction; locking; tractions; removal.—Forceps at brim; operation.—Axis-traction forceps.—Forceps in occipito-posterior positions; in face presentations.

History.—The forceps, it is well known, is the invention of the Chamberlens.* It was held by them as a family secret, and utilized purely as a means of gain. In the early part of the year 1670, Hugh Chamberlen, who enjoyed a great reputation as an accoucheur, went to Paris in the hope of finding a purchaser for it. Mauriceau, to test the value of Chamberlen's pretenses, suggested that the latter should attempt the delivery of a woman with extreme contraction of the pelvis, upon whom he had previously decided to perform the Cæsarean section. Chamberlen declared that nothing could be easier, and at once, in a private room, set about the task. After three hours of vain effort he was obliged to acknowledge his defeat. The woman died; the negotiations for the sale were dropped, and Chamberlen returned with his secret unrevealed to England. In 1672 Chamberlen published a translation of Mauriceau's work upon midwifery, in the preface of which he states: "My father, brothers, and myself (though none else in Europe, as I know) have, by God's blessing and our own industry, attained to and long practiced a way to deliver women in this case without any prejudice to them or their infants, though all others (being obliged, for want of such an expedient, to use the common way) do or must endanger, if not destroy, one or both with hooks." In 1688 Hugh Chamberlen went to Amsterdam and sold his secret to Roonhuysen for a large sum, who in turn disposed of it to Ruysch and others; and, as late as 1746 it was the rule of the Medico-pharmaceutical College at Amsterdam that no one should practice midwifery without first obtaining the secret measure, which was imparted by their examining body for a heavy money consideration. In 1753 Jacob de Vischer and Hugo van de Poll, who had acquired the secret from the daughter of a former possessor, made it public property; but the instrument turned out to be the single-bladed vectis. Whatever doubts, however, this exposure may have

* Dr. J. H. Aveling, in an essay entitled The Chamberlens and the Midwifery Forceps, London, 1882, concludes that the inventor proper of the forceps was Peter Chamberlen the elder, who was taken by his father, a Huguenot fugitive, from Paris to London in 1569. Dr. Peter Chamberlen, who purchased Mortimer Hall, in Woodham, was the son of Peter Chamberlen the younger, a brother of the inventor. Dr. Peter Chamberlen's son, Hugh Chamberlen, Jr., was the translator of Mauriceau's work. His son, Hugh Chamberlen, Jr., was the one whose monument is seen in Westminster Abbey.

cast upon the nature of the Chamberlen secret were set at rest, in 1815, by the discovery, in a former residence of the family in Woodham, in Essex, of a chest containing, besides letters and a variety of patterns of the vectis, a number of pairs of forceps, fenestrated, without a pelvic but with an excellent cephalic curve. Moreover, Chapman, in a short treatise upon midwifery, published by him in 1733, stated that "the secret mentioned by Dr. Chamberlen was the use of forceps, now well known to the principal men of the profession both in town and country." And two years later, in a second edition of his work, he published an engraving of the instrument, which became known as Chapman's forceps, though it did not differ from the one used by the Chamberlens.

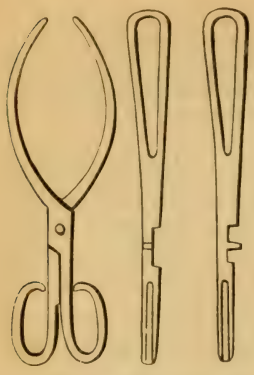


FIG. 144.—Forceps of Chamberlen.

Since Chapman's publication the modifications made in the forceps by obstetric practitioners have been exceedingly numerous. Indeed, nearly every man widely engaged in midwifery practice finds it convenient to possess his own forceps. With few exceptions, however, the various patterns described by authors do not differ materially as regards essential principles, but have each some peculiarity of construction which fits them to supplement a personal defect of the contriver, or to meet some special indication. The forceps is by no means a perfect instrument. It is impossible to construct it in such a way as to cover every need. In consulting practice, it is convenient to possess a number of forceps for different emergencies. A good pair for general use is necessarily a compromise between conflicting aims, and requires, for successful use, experience and intelligence to correct its deficiencies.

FIG. 145.—Forceps of Smellie.

In selecting forceps it is well to bear the following points in mind: We have first to distinguish between the long and the short forceps.

Short Forceps.—The original instrument of the Chamberlens furnishes the type of the short variety. By referring to Fig. 144, it will be seen that the Chamberlen forceps consisted of two levers, made to cross each other like a pair of scissors, with short handles, and blades diverging just beyond the point of articulation. The blades were fenestrated, to lighten the instrument and to enable them to seize the head with greater secur-

ity. They were furnished with a cranial curve, as has been stated, but were straight when viewed in profile. Though somewhat rude in appearance, they were capable of rendering good service when the head had once entered the pelvic cavity. Smellie, in place of the mortise lock of the Chamberlen forceps, which required to be secured by tape or cord, invented the easily adjusted English lock, and covered the handles with wood and a durable coat of leather. The handles were five and a half inches in length, and the blades six inches. Short forceps, modified somewhat from the Smellie pattern, are used by some practitioners at the present day. It has been thought an advantage that they can be concealed in the pocket, and slipped over the child's head without the knowledge of the patient or of the assistants. Smellie laid great stress upon this point, and says: "As women are commonly frightened at the very name of an instrument, it is advisable to conceal them as much as possible until the character of the operator is fully established." In these enlightened days, however, secrecy is no longer advisable. Indeed, the forceps ought never to be used without such exposure of the vulva as will enable the operator to exercise every precaution for the preservation of the perinæum.

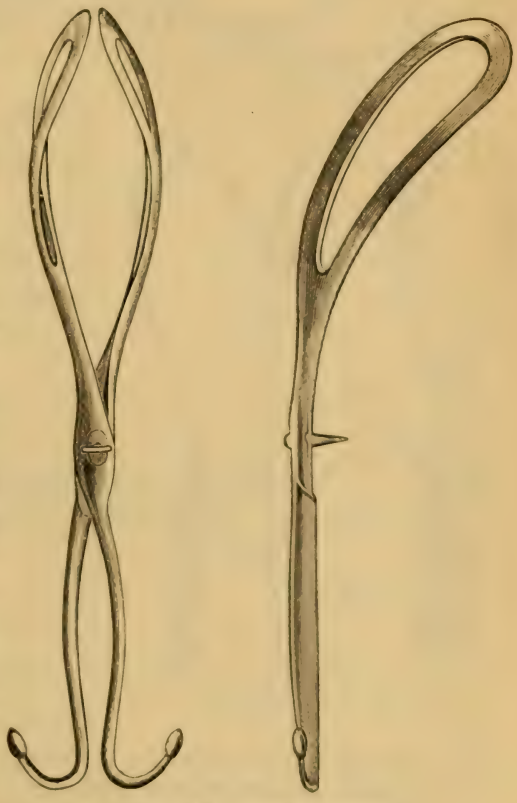


Fig. 146.—Levret's forceps.

Long Forceps.—Smellie tells us he found, in pelves with jutting-in of the sacrum, that he could not push the handles far enough backward to include between the blades the bulky part of the head, which lay above the pubes. He therefore, to remedy this inconvenience, contrived a longer pair, curved on one side and convex on the other. Thus, at an early period the necessity for long forceps was experienced.

Smellie was deeply impressed, however, with the dangers of high forceps operations, and sought to diminish the risks incidental to them by making the handles short, to free himself, as he said, from the temptation of using too great force.

Levret, on the contrary, contemporaneously with Smellie, converted the forceps of Chapman into a powerful tractor and compressor. He retained the iron handles, but roughened the surfaces, and made them slightly convex, to adapt them to the palms of the hand. The articulation was effected by means of a pivot and a mortise. The chief peculiarities, however, consisted in the weight and the length of the instrument and in the extent of the pelvic curve. So far from these features proving objectionable, they have been substantially retained in modern French instruments.

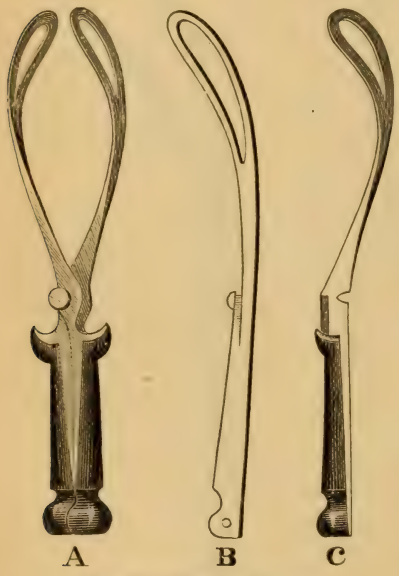


FIG. 147.—Naegele's forceps.

The forceps of Smellie and Levret are the two type-forms from which are derived the great number of the models in vogue at the present day.

The Naegèle forceps, extensively used in Germany, in its main features resembles the instrument of Smellie. It is, however, two inches longer, and there is less disproportion between the length of the handles and the blades. The upper part of the handles is furnished with transverse shoulders, hollowed out for the index and middle fingers of the hand which exerts the traction force. The lock is that of Bruninghausen, and consists of a pivot, surmounted by a flat button, which fits into a notch upon the opposing blade.

The Simpson forceps possesses a relatively short handle, with transverse shoulders, and indentations for the fingers of the under hand. The English lock is improved by the addition of knees or projections to diminish its mobility. The cephalic curve, in place of starting at the lock, is carried away two and three eighths inches by straight, parallel shanks, an arrangement which makes it possible to lock the instrument outside the vulva even when applied to the head at the brim, and which enables the operator to bring the head to the floor of the pelvis without placing the vulva upon the stretch. The pelvic curve does not exceed one inch and a half. I have been in the habit of recommending this forceps to my classes of medical students, on

account of the ease with which it can be applied, its solidity, and the slight markings it leaves, under ordinary circumstances, upon the

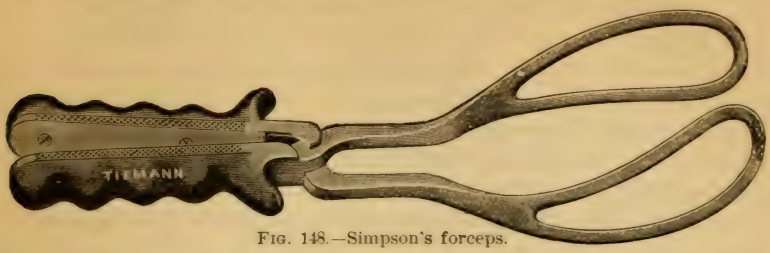


Fig. 148.—Simpson's forceps.

child's head. It is, however, defective in compressive power, when such action is necessary.*

The forceps of Hodge, of Wallace, and of White are extensively used in this country. Like those of French make, they have metal handles, and a lock composed of a movable pivot, which slips into a notch at the moment of adjustment. They are, however, much lighter and of more graceful outline. The shanks are long and superimposed. The blades are provided with wide fenestræ, through which

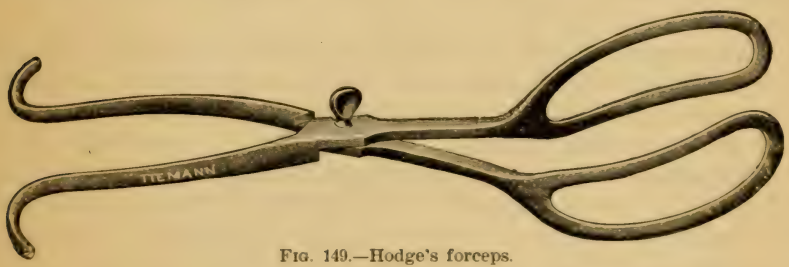


Fig. 149.—Hodge's forceps.

the parietal bosses are intended to project. I have tried each of these instruments, and, though I cling to Simpson's forceps from habit, have found them extremely serviceable.

Finally, in choosing forceps, it is well to remember that, if there are none which are absolutely perfect, there are few which are really poor. Objectionable features are very short handles and thin, springy blades with sharp cutting edges. A good pair of long forceps renders the possession of short forceps a superfluous luxury.

Action of the Forceps.—The forceps is primarily and essentially a tractor. When properly adjusted, it serves as a handle by means of which the head can be withdrawn from the parturient canal. Many excellent operators are in the habit of combining with direct traction

* The instrument-makers of this city are accustomed to make for me an instrument exactly copied from a pair of forceps brought by me from Edinburgh in 1865. Many of the forceps bearing Simpson's name in this country have only a faint resemblance to the original model.

a side-to-side swaying of the forceps-handles, with a view of determining the alternate descent of the lateral surfaces of the cranial vault. No doubt these so-called pendulum movements increase the extractive power of the forceps. The increase is, however, obtained at the expense of the maternal tissues. If employed, therefore, only a moderate degree of traction force should be exerted. As to the efficiency of direct tractions, I am able to speak from experience. At first insisted upon by the Vienna school, they have found warm advocates in Matthews Duncan,* of London, and Albert Smith,† of Philadelphia.

The crossing of the forceps at the lock renders it impossible to resort to traction without at the same time exercising compression upon the child's head. When the forceps is applied laterally over the parietal bones, moderate pressure is harmless to the child, and undoubtedly facilitates in some degree the act of delivery. When the head is high in the pelvis before rotation is completed, the lateral application is rarely possible. If the forceps is applied obliquely, with one blade over the side of the brow and the other over the side of the occiput, bulging takes place in the opposite oblique diameter—a result which tends to retard rather than to aid extraction. Nevertheless, some compressive force is necessary at the brim to seize the head solidly, and to avoid slipping of the blades.

When the blades of the forceps are introduced within the uterus, contractions are apt to be excited. This so-called dynamic influence, though an ancillary property of the instrument, is often of considerable service in aiding delivery.

Indications.—It would be an unprofitable undertaking to enumerate all the conditions which render forceps advisable. The indications for their use may be summed up in two general propositions. The forceps is applicable—1. In cases where the ordinary forces operative during labor are insufficient to overcome the obstacles to delivery; 2. In cases where speedy delivery is demanded in the interest of either mother or child.

Both these propositions are, however, subject to the limitation that, in the selection of the mode of delivery, choice should be made specially with reference to the maternal safety. Fortunately, in the great proportion of cases the interests of both mother and child are identical.

Preparations for Forceps Deliveries.—When it has been decided to deliver by forceps, it is a good plan always to place the patient crosswise in bed, with the head raised by a pillow, and with the hips well over the edge of the bed. To be sure, many prefer, in simple cases, to

* Duncan, Against the Pendulum Movement in working the Midwifery Forceps, Trans. of the Obstet. Soc. of Edinburgh, vol. iv, p. 195.

† Smith, The Pendulum Leverage of Obstetric Forceps, Trans. of the Am. Gynæc. Soc., vol. iii, p. 235.

disturb the patient as little as possible, and pride themselves upon being able to slip on the forceps and deliver without the seeming of an operative procedure. This trifling advantage is, however, more than counterbalanced by the increased risk of injuring the vulva and perinæum, when the operator is compelled to assume a constrained or awkward position.

In this country, as in France and Germany, it is customary to place the patient upon her back; whereas in England she is made to lie upon her left side. The difference is not material. In the description to follow it will be assumed that the dorsal position is the only one likely to be selected.

At the beginning, it is well, in most cases, to bring the patient under the influence of an anæsthetic. This I am accustomed to do before changing the patient's position. In easy cases the accoucheur can administer the anæsthetic before operating, and then leave the continuance of the chloroform- or ether-giving to any intelligent bystander who acts under his supervision. In difficult cases, however, it is better to send for a skilled assistant who is capable of taking entire charge of the anæsthesia, that the operator's attention may not be diverted from the work he has in hand.

Before applying the forceps, care should be taken to ascertain the position of the head, and to make sure that the membranes have freely ruptured. Forceps applied directly to the membranes might do harm by causing a premature detachment of the placenta. The position of the os and the degree of its dilatation should likewise be determined. In excessive anteversion the head sometimes bulges out the anterior wall of the cervix, and thins the cervical tissues to such an extent that the sutures, the fontanelle, and contour of the head can be distinctly felt, as though the head had entered uncovered into the vagina; whereas, in fact, the undilated os is situated high up, and with care may be found looking backward in the direction of the sacrum. It is only necessary to indicate the possibility of such a source of error to insure the caution necessary for the avoidance of forceps applications to the cervix.

As a preliminary to all obstetrical operations, both bladder and rectum should be emptied. The vagina should be washed out with a two-per-cent solution of carbolic acid. The blades of the forceps should be thoroughly cleansed in a warm two-per-cent solution of carbolic acid or should be dipped in boiling water, and the hands of the operator should be disinfected. Soap should be used as a lubricant for the forceps blades and the hands.

Practically it is important to distinguish between forceps operations at the brim and those conducted after the head has entered the cavity of the pelvis. The latter are simple, safe, and easy of accomplishment, requiring only skill in the management of the perinæum;

while the former belong in the category of capital operations, and call for a large degree of patience, experience, and obstetrical tact to bring to a successful issue.

Forceps at the Pelvic Outlet.—The special indications for forceps when the head is low in the pelvis are so-called rigidity of the perinæum, stenosis of the vaginal orifice, and conditions demanding speedy delivery.

The condition termed rigidity of the perinæum is usually the sign of failing uterine action. So long as the labor-pains are good, the external parts progressively soften and relax in preparation for the advancing head. If after the head reaches the floor of the pelvis the pains lose their expulsive character, the perinæum may be rigid simply because the ordinary physiological forces which induce softening are absent, or, in case softening has already begun, the perinæum may become rigid from the sustained pressure to which it is subjected. In either contingency intermittent tractions made with forceps, in imitation of the natural mechanism, furnish the speediest and safest method of overcoming the resistance of the soft parts.

Stenosis of the vulva is sometimes the result of old cicatrices. Oftener it is found where there is faulty direction of the child's head, the vertex bulging the perinæum in place of serving as a dilating wedge to the vulval orifice. The danger of central perforation of the perinæum is best averted by applying forceps and bringing the occiput well forward under the arch of the pubes. The commonest conditions demanding speedy delivery are convulsions, exhaustion, and febrile disturbances in the mother, and dangers threatening the life of the child. It is, however, of great importance to keep in mind the relation that the prolongation of the second stage of labor bears to these very dangers. So long as the head advances through the parturient canal by regular progression, the vagina pours out an abundant secretion of mucus, and relaxation takes place. If the advance of the head is arrested from the dying out of the pains, or from other causes, the continuous pressure exercised by the head upon the soft parts produces venous stasis, œdema, disappearance of the secretion, and finally inflammatory infiltration. The genitals therefore become hot, dry, swollen, and friable, the intensity of the symptoms depending upon the more or less close adaptation of the head to the bony walls of the pelvic cavity. It is easy to understand that with these conditions the temperature rises and the pulse becomes frequent; if the urethra is compressed, retention of urine with convulsions may follow; while, as after-results, we may have phlegmasiæ extending to the pelvic cellular tissue and thence to the peritonæum. Pressure too long continued can produce necrosis, and, as sloughing occurs, vesico- and recto-vaginal fistulæ. At the same time there is reciprocal pressure exercised by the bony walls upon the child's head, and close retraction of

the uterus upon the fœtus. The first cause may lead to retarded heart action and intra-cranial extravasations of blood; while the second is a fruitful source of asphyxia, owing to the diminution of the maternal blood-currents which circulate through the placenta.

In view of the foregoing, it will be seen that forceps is not alone indicated in the presence of perils fully developed, but is of still greater service as a prophylactic against the dangers of an unduly lengthened second stage.

It is in vain to lay down well-defined rules as to the precise time at which the forceps should be applied. Formerly it was advised to wait for the advent of a thin, reddish-brown discharge. As the latter simply consists of serum commingled with blood from overstrained capillaries, it furnishes a sign that delivery has been delayed too long. Some counsel applying forceps two hours after the completion of the first stage of labor, and proclaim longer waiting a useless barbarity. Clearly, however, it is not so much the length of the second stage of labor which furnishes the indication for forceps as the degree of the reciprocal pressure exercised between the head and the pelvis. A valuable index to this pressure is furnished by the caput succedaneum. In the second stage, a scalp tumor of large circumference can only be produced by the circle of the bony pelvis. Such a tumor, increasing in size, without any evidence of progress in the delivery, is a significant evidence of pressure, and furnishes, therefore, the most reliable indication for forceps.

Whether the ease with which forceps can be applied at the outlet, and the safety which attends its employment, justify its use as a means of saving the physician's time, or the patient from an additional half-hour of suffering, are questions which are at least debatable. I can only say that, with increasing experience, my own practice has grown more and more conservative, and my own belief is that true wisdom requires us to abstain from even trivial operations so long as Nature is able to do her work without our assistance.

The operation consists of four acts, viz.: 1. Introduction of the blades; 2. Locking; 3. Tractions; 4. Removal of the instrument.

Introduction of Blades.—In introducing the forceps, each blade, if a long one with pronounced pelvic curve, should be seized like a pen near the lock, and should be held nearly vertically, with the extremity in correspondence with the slit-like opening of the vulva. In the Simpson forceps, which possesses only a moderate pelvic curve, the handle should be lightly grasped in the half hand, and held at the outset nearly parallel to Poupart's ligament. Owing to the arrangement of the lock, the left blade should be passed first. The handle should accordingly be held in the left hand, while two or three fingers of the right hand, inserted between the head and the vagina, serve to guide and guard the point during its introduction. The pas-

sage of the blade should take place only during the intervals between the pains. It is customary to pass each blade at first opposite the sacro-iliac articulation, and then to change the direction as required, after the point has reached the *linea terminalis*.

In introducing the forceps-blades, the two curves of the instrument should be borne in mind. By directing the handle toward the thigh of the mother which corresponds in name to the blade, the latter is made to glide over the convex surface of the child's head; by sinking the handle, the pelvic curve follows the axis of the pelvis. The two

FIG. 150.—Introduction of blades.

movements should be made slowly but simultaneously, and under the guidance of the inserted fingers. But slight force is necessary. The point of the blade should impinge rather upon the fingers than upon the child's head. When the left blade is in place, the handle should be lowered and intrusted to an assistant. The right should be introduced on the right side, under the guidance of two to three fingers of the left hand, in accordance with the same general rules.

The cephalic curve of the forceps is intended to correspond to the

lateral surfaces of the child's head. When the rotation of the occiput under the symphysis is complete, it is only necessary to sink the handles to make the blades assume the natural position over the parietal bosses. If the head is still in an oblique diameter, the forceps should be applied in the opposite oblique diameter. When, therefore, the occiput is left anterior, the left blade should be allowed to remain opposite the sacro-iliac articulation, while the right blade, by sinking and at the same time rotating the handle, is swept forward to the right acetabulum. If the head is right anterior, the left blade is at once swept forward toward the left acetabulum, while the right blade is allowed to remain opposite the sacro-iliac articulation. If the sagittal suture

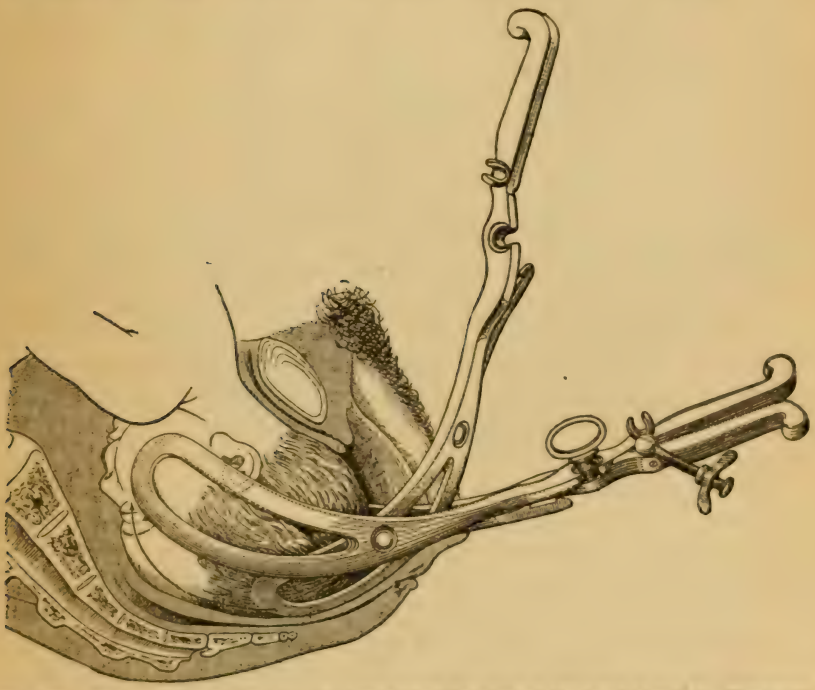


FIG. 151.—Blades of the Tarnier forceps adjusted to the sides of the head at outlet. The arrow indicates the direction taken by the right blade in its introduction. (Farabœuf and Varnier.)

occupies the transverse diameter, the forceps should be applied in the oblique diameter of the same name as the side toward which the occiput is turned. This is best accomplished by first applying the forceps in the usual way; then, leaving the occipital blade in the excavation to the side of the promontory, with the guiding fingers inserted into the vagina, direct the frontal blade forward toward the acetabulum. During this manœuvre the handle should be held loosely. The forceps will seize the head very nearly between the anterior frontal and the opposite posterior parietal protuberance. The direct application of the forceps

to the sides of the head, with one blade beneath the symphysis and the other opposite the promontory, has, however, warm advocates. There is no question that the head can be delivered in this way, but my own experience has been entirely with the oblique method.*

Locking.—When the occiput is rotated to the front, and the blades are applied to the sides of the head, locking is a very simple matter. The handles should be grasped in the full hand, with the thumbs directed upward. Coaptation is secured by slight movements of the blades as the operator sinks the handles downward.

When the head is transverse it is often, on the contrary, difficult to bring the separate parts of the lock in apposition. Under such circumstances no force should be used, but the blades should be withdrawn a little, and the attempt made to adjust the lock by gentle movements in reintroducing them.

After locking, a tentative traction should be made to ascertain whether the head is seized securely. In bringing the blades together some caution should be observed lest the hair of the pubes, or the labia, become included.

Tractions.—The instrument should be seized with the right or stronger hand, with the back of the hand turned upward. In forceps provided with transverse shoulders, the index-finger should be placed over one shoulder, and the remaining fingers over the other. The left hand, with the palm upward, seizes the handles from below and aids in extraction. When the handles are far apart, the index-finger of the left hand should be introduced into the vagina from time to time, to determine the position of the forceps-blades, and to estimate the amount of pressure upon the child's head during tractions.

Steady tractions are preferable to pendulum or rotary ones. Tractions are most effective when made during a pain. This is especially the case when the rotation of the head is incomplete. However, in the absence of pains, it is often necessary to use the forceps as a substitute for, instead of a re-enforcement of, the propulsive action of the uterus. Pressure through the abdominal walls upon the uterus, made by a skilled assistant during tractions, is here, as in other obstetrical operations, an adjuvant of great value. Tractions should not be too prolonged. When not made in unison with the pains, they should not exceed one to two minutes in duration. The head should then be allowed to recede. Haste in delivery exposes the patient to the dangers of laceration and *post-partum* hæmorrhage. The alternate descent and recession of the head soften the external parts, and are the best means of overcoming rigidity. As the head advances, time should be given for the uterus to retract upon its contents, for, when the

* In a recent beautiful work entitled Introduction à l'étude clinique et à la pratique des accouchements, by Professor Farabœuf and Dr. Varnier, the direct application is strongly favored.

pains are deficient, retraction after the sudden emptying of the uterus is apt to be imperfect or of short duration.

Tractions should at first be made downward, until the head has descended below the symphysis pubis; they should then be made in a horizontal direction until the occiput appears at the vulva. When in doubt about the direction, the handles should be held loosely during a pain, to serve as an index of the proper line of traction. If rotation has not previously taken place, it may be aided by the forceps, though

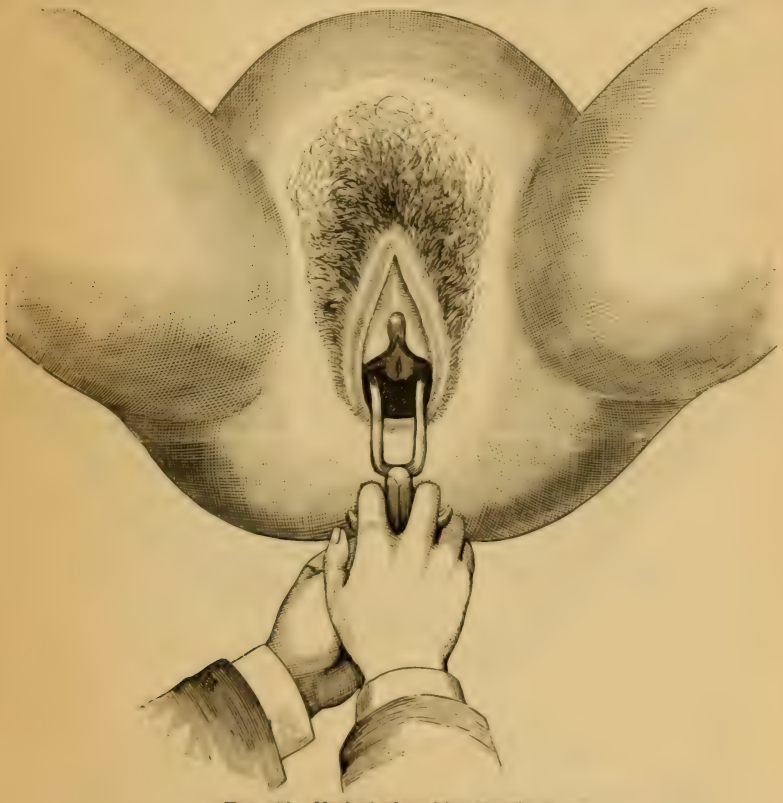


Fig. 152.—Method of making tractions.

rotation usually occurs spontaneously as the head descends. If the head was transverse, the forceps requires to be readjusted after rotation, either by removing the blades and then reapplying them, or by sinking the handle of the posterior blade and raising the handle of the anterior one.

When the parietal bosses are in the act of passing through the vulva, tractions should no longer be made during the pains. The operator should stand to the right of the patient, and seize the handles in the left hand. During the intervals of a pain, by alternately sink-

ing and raising the handles, the perinæum and vulva can be gradually dilated. So soon as the convexity of the perinæum is marked, and the parietal bosses press upon the commissure, it is better to sink the handles during a pain, so as to flex the head to its greatest extent, and cause the vertex to present. When the vulva is sufficiently dilated, it is only necessary to raise the handles toward the abdomen to complete the extrusion of the head and finish the delivery.

Removal.—Although not generally recommended, it is always my custom to remove the forceps so soon as the chin can be reached by the

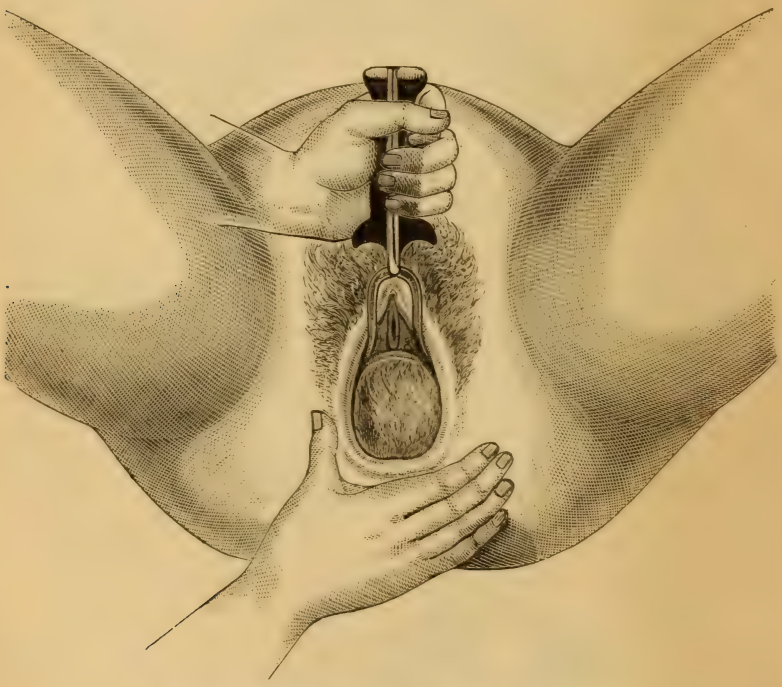


FIG. 153.—Position of operator when head is on perinæum.

index-finger introduced into the rectum. The head has then for the most part emerged from the pelvis, and its extrusion, if it does not occur spontaneously, can be easily effected by any one reasonably familiar with the mechanism of parturition. The blades of the forceps, though of no great thickness, still add something to the distention of the vulva. Moreover, with expert management, the guidance of the head through the vulva and the utilization of all unoccupied space beneath the pubic arch can be accomplished much more safely by the hand than by the most skillful use of the forceps. The removal is accomplished by unlocking and reversing the direction the handles followed in their introduction. To avoid compressing the soft parts

against the rami of the pubes, I am accustomed to place two fingers of the unemployed hand upon the upper border of the blade, and use them as a fulcrum around which the blade should be rotated.

Forceps at the Brim.—The safe conduct of the head through the pelvic brim by means of the forceps is an achievement which requires an accurate appreciation of the dangers to be avoided and the difficulties to be overcome. The forceps as a means of accelerating delivery is sometimes called for when the head is at the brim in cases of accidental hæmorrhage, of placenta prævia, of eclampsia, of pelvic obstruction, and in failure of uterine pains.

So long, indeed, as the head is movable at the brim, and version is practicable, the latter operation furnishes the safer mode of delivery.

FIG. 154.—Forceps applied to head at brim.

After the waters have drained away, and retraction of the uterus renders version impossible, a tentative application of the forceps may be made to test the adaptability of the head to the pelvic canal. Persistent attempts to drag the head into the pelvis by brute force, after moderate tractions have failed to effect an advance, should be regarded as criminal, exposing as they do the maternal tissues unavailingly to injuries which are always serious, and which may prove fatal.

When, however, the head has become fixed, which does not occur until after the engagement of its largest circumference, and after the dilatation of the cervix is complete, the difficulties of high forceps operations are greatly diminished. Still, dangers to the mother arise from the fact that the blades have to be passed into the lower segment

of the uterus, where, owing to the extreme vulnerability of the uterine tissues, lesions are only to be avoided by the patient carrying out of a multitude of precautionary measures; to the child, from the rarity of the occasions which permit the blades to be applied to the sides of the head, to which the cephalic curve is alone adapted.

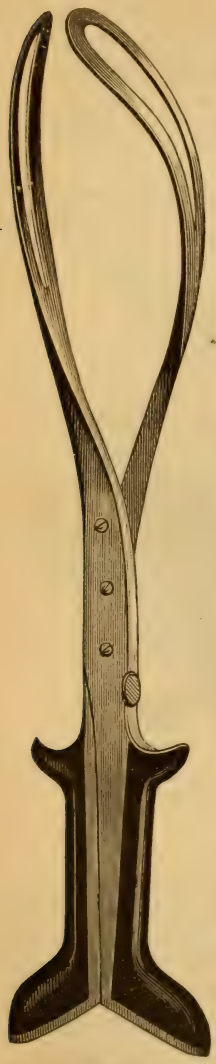


Fig. 155.—Taylor's narrow-bladed forceps.

Operation.—In introducing the forceps, the tips of the fingers of the guiding hand should be inserted between the child's head and the cervix. In this way we insure the entrance of the extremities of the blades into the uterus in place of into the *cul-de-sac* of the vagina. It is generally customary to apply the forceps to the sides of the pelvis, without reference to the position of the child's head. As a rule, under the conditions mentioned, the head will be found to have been seized obliquely—i. e., with the posterior blade over the parietal boss, and the anterior blade near the coronal suture. Thus applied, close approximation of the handles is impossible, and the tips are correspondingly separated from one another. Considerable compression of the handles is necessary, therefore, to prevent the instrument from slipping, the degree of pressure depending naturally upon the extractive force requisite to advance the head. The adjustment of the lock often requires considerable patience, and sometimes the exercise of moderate force is necessary to bring the parts into juxtaposition.

Even when the instrument has been applied according to the strict rules of art, it will be found not infrequently that the upper border of the anterior and the lower border of the posterior blade will project beyond the tissues of the scalp, and, unless managed with care, the exposed edges are liable during extraction to cut deeply into the soft structures of the parturient canal.

When the cervix is only partially dilated, the forceps should be employed, not as an extractive instrument, but simply to bring the head into the cervical canal to act as a dilating wedge, by means of which the gradual and safe expansion of the os may be accomplished. If the head be made to descend and then allowed to recede at short intervals between the pains, in time the cervix will be found to soften and yield in the same manner as a rigid perinæum;

whereas the resistance of an undilated cervix can only be overcome, when violent tractions are made, by the production of lacerations extending to, or even above, the vaginal junction. In seeking to effect dilatation of the cervix through the forceps, the utmost caution should, however, be observed. At short intervals the finger should be slipped into the vagina to note whether the tension of the cervix is raised during tractions to dangerous proportions. Especial attention should be paid to the condition of the parts during a pain, as, when the uterus contracts, the os externum, which previously was soft and dilatable, frequently forms a sharp, resistant border.

Dr. I. E. Taylor has devised a long, narrow-bladed pair of forceps, capable of introduction through a cervix measuring one and a half inch in diameter, which he has used with advantage in the manner above described at a very early stage of labor.

In cases where it is necessary to expedite delivery, the resistance of the incompletely dilated os may be overcome by a number of incisions about one fourth of an inch in depth, made with a blunt-pointed bistoury passed between the cervix and the child's head. It is very rare, however, that this otherwise trivial operation is really called for.

In drawing the head through the superior strait, the tractions should be made, as nearly as the perinæum will permit, vertically downward. In doing this, care must be taken lest the pelvic curve be brought so far forward above the symphysis pubis as to subject the maternal tissues to injurious pressure. On the other hand, it is necessary not to prematurely raise the handles of the forceps, as, in that case, the head is simply crowded forcibly against the anterior pelvic wall. The best means of avoiding these two difficulties is to exercise great patience, and be content with a very gradual advance of the head, as, by omitting anything like rude force, the risks arising from misdirected tractions are kept within the limits of safety. Many, indeed, seek to prevent the anterior pressure of the forceps, by placing the left hand upon the lock, and using it as a fulcrum around which rotation of the instrument is effected. As the right hand has then to be employed at the same time to make tractions and to raise the handles, the method requires both strength and expertness to be successful.

In all high operations where the cervix is sufficiently dilated, I can not too strongly recommend the ingenious forceps of M. Tarnier, which, by its construction and action, obviates to a great extent the foregoing objections to the more familiar models.

M. Tarnier's original model possessed two distinctive features: 1. The shanks, in place of running forward continuous with the pelvic curve, were bent backward, so that the handles, when placed horizontally, occupied a level three and a half inches above the plane of the posterior curve of the blades. This Tarnier curve was intended to

make it possible to adjust the blades to the sides of the pelvis at the brim, without subjecting the soft parts in front or the perinæum below to pressure. In high operations such a curve is of undoubted advantage, but at the lower strait, unless the blades are accurately applied to the sides of the child's head, the posterior borders of the blades are apt to cut deeply into the vaginal wall, so soon as the converging soft parts embrace tightly the advancing head. Probably for this reason Tarnier, in his latest model, has restored to his instrument the ordinary pelvic curve. 2. The second and permanent feature consists in the attachment of two movable traction-rods to the lower curvature of the blades. These rods are curved, according to the model employed, to correspond to the lower border of the shanks. In Tarnier's instrument the rods, when not in use, are affixed by projecting pegs. A transverse screw, crossing the handles below the lock, approximates the blades to the surface of the child's head. When the instrument is adjusted, the outer ends of the traction-rods are detached and inserted into a socket-joint belonging to a strong steel bar with a downward curve, and furnished with a transverse handle which can be moved in any direction by means of a universal joint. Tractions are made by means of this transverse handle alone. As the head descends, the handles proper rise upward and serve as an index to show the direction in which the force should be exerted. By simply raising the traction-rods in a line with the curved shanks, the blades of the forceps swing

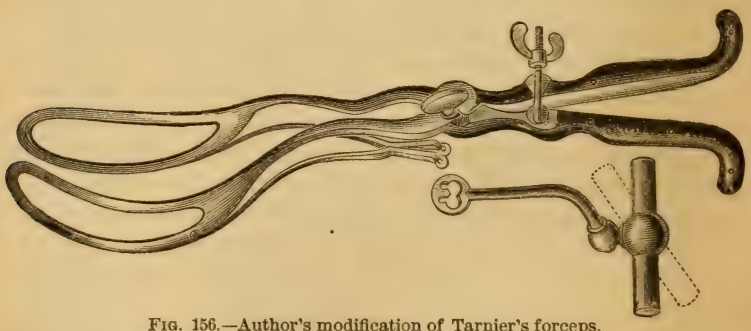


Fig. 156.—Author's modification of Tarnier's forceps.

always in the transverse diameter, and the head follows approximately * the axis of the pelvis. To one accustomed only to the familiar forceps, the facility with which delivery can be accomplished by Tarnier's instrument would seem hardly credible.

* I use the word "approximately," for my own experience does not sustain the idea that the handles of the forceps furnish an infallible guide to the direction in which tractions should be made. In this respect I am in entire agreement with Breus (Die Becken-Eingangs-Zangen, Vienna, 1885), viz., that the advantage of the Tarnier principle consists less in the mathematical accuracy of the tractions than in the freedom of motion that the traction-rods permit to the head.

Mr. Stohlmann has modified for me the original forceps of Tarnier by making the blades much lighter, modeling them somewhat after those of the well-known instrument of Wallace. This alteration makes their application, especially in contracted pelves, or through an imperfectly dilated os, a much easier matter. In place, too, of the very clumsy socket-joint into which the traction-rods are inserted, he has substituted the key arrangement shown in Fig. 156, by means of which the handle can be adjusted or removed in a few seconds of time.

In spite of the example of the illustrious author of the axis-traction principle, I still cling to the Tarnier curve. It enables the operator to seize the head more advantageously at the brim, and, in my experience, it facilitates greatly the descent of the head in the axis of the superior straits. Mr. Stohlmann has recently made for me a pair of narrow-bladed forceps with axis-traction rods and Tarnier curve, for cases in which the dilatation of the cervix is insufficient to permit the introduction of the wide blades of the ordinary instrument. In high operations, the operator will find axis-traction most effective when the patient is placed upon her left side.

When the head has been brought to the floor of the pelvis, unless the occiput has previously turned to the front, it is a good plan to remove the forceps and wait for spontaneous rotation to take place. If a reapplication becomes necessary, an instrument with the ordinary curve should be selected.

Professor Alexander Simpson, of Edinburgh, has contrived an admirable instrument for general use by adapting traction-rods to the popular and widely employed forceps of Sir J. Y. Simpson. The rods as well as the handles are permanent fixtures, so that there is no possibility of the parts being mislaid when required for service. I have given this instrument an extended trial, and regard it as a most valuable addition to my obstetric equipment. With the head in the pelvic cavity it answers every indication. In high operations, however, I have sometimes found it convenient to lay it aside for a longer forceps with a backward curve.

As the solidity of the shanks in axis-traction forceps prevents the blades from springing, the amount of pressure upon the head requisite to keep the instrument from slipping has been found in practice not to prove an element of danger to the child.

Forceps in Occipito-posterior Positions.—So long as the occiput looks to the rear, it is the rule in midwifery practice to refrain from the use of forceps, which, of necessity, prevents forward rotation from taking place. An exception to this rule, however, arises in cases of a near danger to either mother or child, demanding speedy delivery. As attempts to rotate the occiput around to the symphysis by instrumental means are rarely successful, it is advisable under such circum-

stances to apply the forceps directly to the sides of the child's head, and to imitate during delivery the mechanism of labor in occipito-posterior positions.

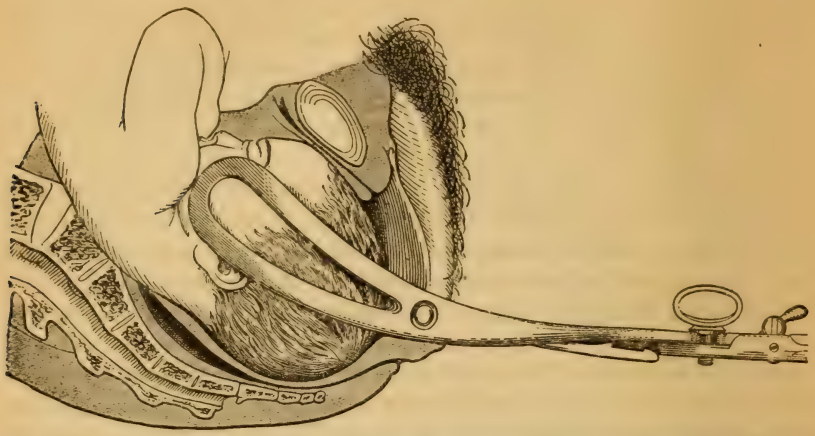


FIG. 157.—Occipito-posterior position. Traction in a downward direction to secure the descent of the head beneath the pubic arch. (Farabœuf and Varnier.)

The rotation of the occiput forward to the symphysis pubis by forceps seems, *a priori*, a simple matter, and it would be if the vagina were a rigid canal with fixed extremities. In reality it is an elastic tube, closely applied to the child's head, and enjoys a great degree of mobility. When, therefore, the head is turned a quarter-circle within the pelvis, the soft parts, as a rule, are turned with it. When the force is removed, the vagina, owing to its resiliency, resumes its former position, and generally carries the head back to the original point of departure.

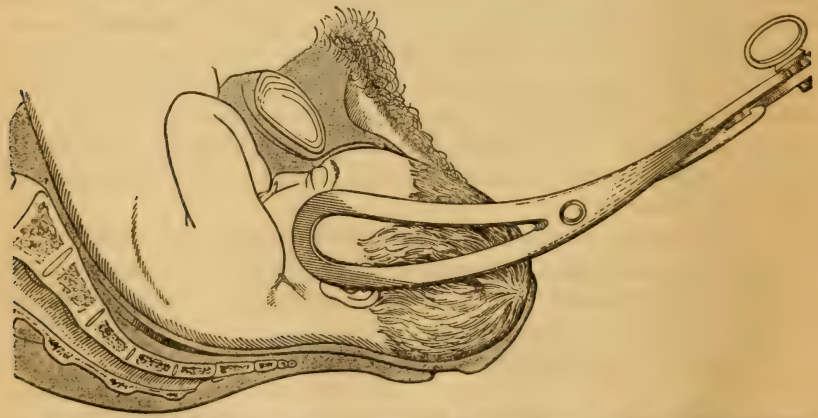


FIG. 158.—Occipito-posterior position. Descent of forehead beneath pubic arch completed. Elevation of handle of forceps to aid the rotation of the occiput over the perinæum. (Farabœuf and Varnier.)

If the sagittal suture occupies an oblique diameter, the forceps should be applied in the opposite oblique diameter. As the head de-

scends, the occiput should be turned into the hollow of the sacrum. At first, tractions should be made directly downward, until the forehead has passed under the pubic arch and the anterior fontanelle makes its appearance at the vulva; then, by raising the handles, the small fontanelle should be brought forward to the commissure, and, finally, as the vertex emerges from the vulva, the handles should be slowly depressed, to aid the movement of extension by which the delivery of the face and chin beneath the pubic arch is accomplished.

Forceps in Face Presentations.—When the face is deep in the pelvis and the chin has rotated to the front, forceps applications are easy, and do not differ materially from those in vertex presentation, except that care should be taken to direct the blades far enough backward to securely seize the occipital extremity of the child's head. Tractions should be made in a horizontal direction until the chin has been brought well under the symphysis pubis, when the handles should be raised to lift the cranial vault over the perinæum. In oblique mento-anterior positions, Spiegelberg advises introducing first the blade corresponding to the chin (posterior blade), as, in adjusting the second blade and locking the forceps, spontaneous rotation usually takes place.

In deep transverse positions, forceps operations should be deferred as long as possible, as tardy rotation of the chin to the front is a physiological peculiarity in face presentations. The forceps should be applied in an oblique diameter, with the concavity of the blades directed to the side of the chin. Chin right, introduce the right blade posteriorly, and bring the left blade forward to the left tuberculum iliopubicum. An effort should then be made to rotate the chin to the front. If the attempt prove successful, the forceps should be unlocked, and the blades readjusted to the lateral surfaces of the head. Tractions when the face is transverse should not be attempted. The wide separation of the blades makes it necessary to compress the handles firmly to prevent slipping. When this is done, pressure upon the neck and thorax is unavoidable, so that extraction without sacrificing the life of the child is hardly possible.

In high transverse positions, forceps should not be used, as rotation is not then permissible, and the blades, applied to the neck and thorax on the one side and upon the cranium on the other, can not, for the reasons just given, be safely employed in extraction. The choice in such cases, when speedy delivery is called for, lies between version and craniotomy.

In mento-posterior positions, the rotation of the chin to the front by repeated applications of the forceps is inadmissible. In practice, such efforts do not succeed, while they are calculated to inflict injury upon both the mother and the child. Usually, if delivery becomes necessary because of danger to the mother, craniotomy should be re-

sorted to. Smellie, Hicks,* and Braun, of Vienna, have, however, each reported a case of forceps delivery by drawing the chin down over the sacrum and perinæum, when the occiput and calvarium glided

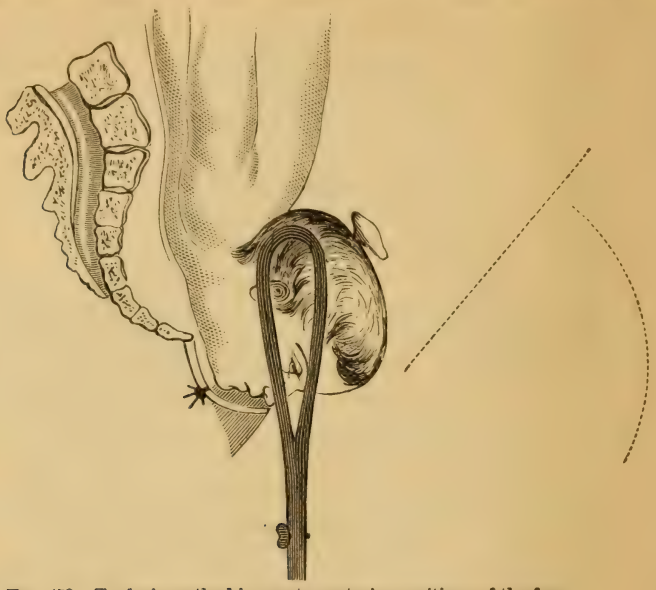


Fig. 159.—Taylor's method in mento-posterior positions of the face.

underneath the pubes. In two cases, I. E. Taylor † extracted the children with straight forceps after bilateral incision of the perinæum. Unfortunately, both children were dead before the operation was undertaken.

CHAPTER XX.

EXTRACTION IN FOOT AND BREECH PRESENTATIONS.

Extraction in pelvic presentations.—Attitude of the physician.—Prognosis.—Position.—Extraction of trunk.—Extraction by the feet; by the breech.—Management of the cord.—Liberation of the arms.—Exceptional cases.—Extraction of the head.—Smellie's method.—Veit's method.—Head at brim.—Prague method.—Forceps to the after-coming head.

We have already seen, in studying the management of breech presentations, that the attitude of the physician during delivery, so long

* Hicks, On Two Cases of Face Presentations in the Mento-Posterior Position. Trans. of the Obstet. Soc. of London, vol. vii, p. 56. Hicks likewise reports the cases of Smellie and Braun.

† Taylor, On the Spontaneous and Artificial Delivery of the Child in Face Presentations, N. Y. Med. Jour., Nov., 1869.

as no immediate danger threatens either the mother or the child, should be one of watchful observation. As a rule, the results to the child are unquestionably more favorable when Nature does her work unaided. If, however, there be any faltering in the natural forces, the physician should be in readiness to avert, by prompt interference, the perils which in pelvic presentations are associated with delay. When an artificial breech-presentation has been produced by internal version, immediate extraction is usually advisable, as the act of version, when the entire hand has to be introduced into the uterus, is apt to compromise the safety of the child.

Strong uterine contractions, a roomy pelvis, a dilated cervix, and a relaxed state of the vaginal outlet, are conditions highly favorable to the success of the operation. Under such circumstances, artificial delivery can be performed with celerity and ease. But these conditions, however desirable, are not absolutely indispensable. Thus, extraction is rarely indicated if the pains are good; it is often necessary to deliver before the cervix has reached the desirable degree of dilatation; and it is possible to drag the head of the child through a moderately contracted pelvis without inflicting upon it any permanent injury. There is always danger, however, in the last two cases, of not being able to extract the child rapidly enough to save it from asphyxia.

The prognosis for the mother is generally favorable. Still, lacerations are apt to follow the forcible delivery of the head through the undilated cervix.

Extraction is commonly performed with the patient on her back. In easy cases she may occupy the usual position in bed, while the physician places himself at her side. If difficulty is anticipated, the patient should be placed crosswise, with hips raised by a hard cushion, and brought over the edge of the bed; or, better still, may be placed upon a table, as the operator is then enabled to draw downward in the direction of the superior strait without kneeling before her. It is desirable to have two assistants to hold the patient's knees. To one of these should likewise be assigned the duty of making firm pressure, during extraction, upon the fundus of the uterus. If anæsthesia is thought necessary, a third assistant will be required. The question of anæsthesia is not always easy to decide. Useful in unruly patients, and where the entire hand must be passed into the vagina, its occasional suspensive action upon the uterine pains and the loss of the co-operation which intelligent patients are capable of affording are alloys to its beneficent action in stilling pain. My preference is to anæsthetize lightly at first, and then be guided by events as to whether the insensibility shall be subsequently made complete, or the patient be allowed to return to partial consciousness.

As in all obstetrical operations, in addition to the usual aseptic precautions, care should be taken to insure the emptying of the bladder

and rectum, and the operator should have in readiness, in case of need, forceps, a soft fillet, warm napkins, hot and cold water, and a small English (No. 7) catheter, for use should the child be born in a state of partial asphyxia.

The operation is divisible into three acts: 1. Extraction of the trunk as far as the shoulders; 2. Extraction of the arms; 3. Extraction of the head.

First Act: Extraction of the Trunk to the Shoulders.

The extraction of the trunk should take place slowly, with pauses between the tractions, in imitation of the uterine expellent forces. Tractions are best made during the pains only, when the latter do not recur at too long intervals. It is desirable that the uterus be closely retracted upon the child during the entire period of its expulsion. Where this does not occur, the arms are liable to be brushed upward to the sides of the child's head, the chin to become extended, and the mechanism of the head-delivery to be disturbed. Hæmorrhage, too, is more likely to follow hasty delivery than where the uterus has had time to pass slowly into a state of complete retraction. When, therefore, it is necessary to extract during the intervals between the pains, firm pressure should be made upon the uterus through the abdominal walls, so as to maintain them in close contact with the fœtus. Steady tractions are preferable to pendulum movements. Tractions should be made downward and backward, in the direction of the superior strait, until the breech meets with the resistance of the floor of the pelvis.

These general rules are applicable to every case of extraction. Special differences of procedure result from the presentation of one or both feet, and of the entire breech.

Extraction by the Feet.—If a single extremity presents, the foot should be seized between the middle and index finger, with the thumb upon the sole, or across the instep. It is not necessary to go in search of the second foot, unless it crosses the first, or is reflected upward over the child's back. When the leg is drawn outside of the vulva, it should be wrapped in a warm napkin, and grasped by the entire hand. Always, in seizing a limb, the thumb should be directed upward and applied to the dorsal surface. The napkin serves partly to prevent the hand from slipping, partly to protect the surface from air, which at times is capable of exciting reflex respiratory movements. Tractions should be made downward, to avoid friction at the symphysis pubis. Until the pelvis is delivered, the child should be seized as near the maternal parts as possible. The hand, therefore, should be shifted upward as the limb is drawn out of the vulva. Whichever extremity is seized rotates forward under the symphysis pubis during extraction. For this reason, when an election is practicable it is desirable to draw upon the anterior leg, since owing to the slight amount of rotation

involved there is less likelihood of derangement of shoulder and head mechanism as these engage in the pelvis. So soon as the breech reaches the pelvic floor, traction should be made more in an upward direction, to facilitate the passage of the buttocks over the perinæum. After the breech has cleared the vulva, the index-finger of the free hand should be carefully inserted into the fold of the posterior thigh, while the thumbs of both hands are placed upon the sacrum. During the subsequent extraction of the trunk the lower leg falls from the vagina without special assistance.

If both extremities present, they should be seized so that the middle finger is placed between the feet, while the index- and ring-fingers encircle the external malleoli. After they have passed sufficiently far outside the vulva, the left leg should be seized with the left hand and the right foot with the right hand. During extraction the normal rotation of the child may be aided by dragging with somewhat greater force upon the limb, which should be turned to the front.

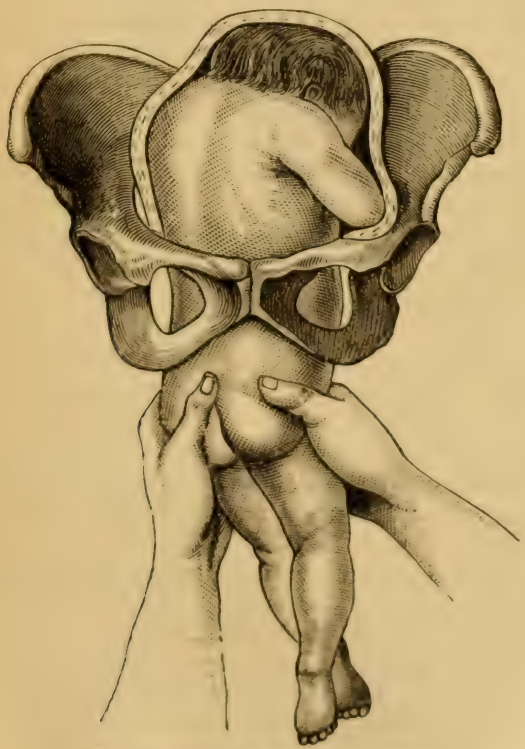


FIG. 160.—Method of seizing the breech.

Extraction by the Breech.—When the breech alone presents, with both extremities reflected upward parallel to the anterior surface of the

child, spontaneous delivery is sometimes, as pointed out by Tarnier, prevented by the fact that the extended limbs act as splints which interfere with the lateral flexion of the trunk, and, consequently, with its accommodation to the curve of the parturient canal. If, in pure breech cases, obstetrical aid becomes necessary, the operator is embarrassed by the absence of a natural handle by means of which extraction can be effected.

Theoretically, cephalic version by external manipulations, performed during the latter part of pregnancy or in the early stages of labor, most completely fulfills the required indications, viz., the saving of the child with the least possible risk to the mother. That, in cases where the breech is not engaged in the pelvic cavity and the membranes are intact, external version may be successfully accomplished, has been shown by Mattéi, Hégar, and Pinard. Tarnier at first opposed the measure on the ground of its impracticability and the risk of rupturing the membranes before the version was completed, thus converting a breech into a shoulder presentation, but more recently has practiced the procedure in many cases without inconvenience to the mother or child.* Its successful performance presupposes a relatively considerable quantity of amniotic fluid, the absence of reflex irritability in the patient, and experience on the part of the operator in mapping out the fœtus through the abdominal wall. Ahlfeld† advises that in primiparæ the hand be introduced immediately after the rupture of the membranes, or at least while the introduction is still practicable, and that the anterior extremity be brought down as a prophylactic measure, leaving the child to be expelled subsequently by the natural forces. The hand should be passed over the anterior surface of the child to the knee; the thumb should then be placed in the popliteal space, while four fingers grasp the leg, flex it upon the thigh, and draw it down into the vagina. The operation is facilitated by placing the patient upon the side to which the child's feet are turned. But Küstner, in common with most authorities, objects that the manœuvre is apt to weaken the uterine contractions and to favor prolapse of the cord. In others words, in order to avert a remote danger, a near one quite as serious is invited.

If, however, it becomes necessary to expedite delivery, without doubt, in all cases where it is possible to pass the hand to the fundus and bring down an extremity without imperiling the uterine structures, this method should be employed by preference. But emergencies rarely arise before the breech has descended into the pelvic cavity. Most frequently the membranes have already ruptured, and the uterus has retracted upon the fœtus. Under such conditions the intro-

* Ollivier, De la conduite à tenir dans la présentation de l'extrémité pelvienne, Mode des fesses, p. 103, Paris, 1883.

† Ahlfeld, Arch. f. Gynæk., vol. v, p. 174, Berlin, 1873.

duction of the hand and forearm over the anterior surface of the child to the fundus becomes a serious undertaking, and may lead to uterine rupture. Traction upon the extremity seized is not always followed by its descent, and where force is used the descent may be accomplished

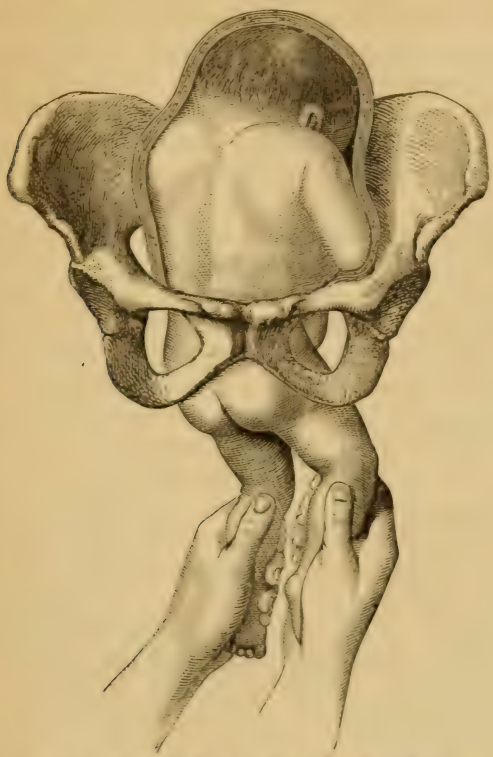


FIG. 161.—Method of seizing both extremities.

at the expense of a fracture. To be sure, the manœuvre is supported by the high authority of Dr. Barnes. "The wedge formed by the extended legs and the upper part of the trunk must," he says, "in some instances at least, be decomposed before delivery can be effected." He recommends complete anæsthesia, support of the fundus, gentleness in passing the breech at the brim, and applying the fingers to the instep. But Barnes does not conceal the difficulties of the operation, nor the address requisite for its successful employment, and many accoucheurs, less fortunate, have recorded their failures to decompose the wedge in the manner advised. In a few cases, influenced by Barnes's teachings, I have, under most difficult conditions, succeeded in bringing down a foot; nevertheless, I would advise the utmost caution in practicing the method, and that in all cases the operator desist the moment address fails and force becomes necessary. If, at the time intervention be-

comes necessary, the breech is well engaged, the fœtus is of ordinary size, and the resistance of the pelvic floor is inconsiderable, the expulsion of the child may sometimes be effected by graduated pressure upon the fundus of the uterus. Should this measure prove ineffective, manual extraction should be attempted. To this end the index-finger should be inserted into the fold of the anterior groin and traction made directly downward. By seizing the wrist with the disengaged hand, an increase of traction-power can be exerted. If the breech is low, both index-fingers may be employed—the one in the anterior, the other in the posterior groin; or the entire hand, passed over the sacrum, may seize the pelvis with the thumb in one groin and the index-finger in the other.

Many writers insist upon manual extraction to the exclusion of all other methods; but in primiparous women they are liable to fail at the critical moment. Instrumental aids then become necessary. The choice consists in the forceps, the fillet, the blunt hook, and, when the child is dead, the cephalotribe. So far as the relative value is concerned, I would recommend them in the order given.

The chief objection urged against the forceps is that, by its construction, it is designed to seize the fetal head. As a consequence, when applied to the breech to which its curves are not adapted, it does not grasp the presenting part securely, and is liable to slip off when tractions are employed, thus endangering the maternal soft parts. If, with the view to prevent slipping, the handles be compressed firmly, it has been argued that fracture of the thighs may result, the circulation of the cord may be accidentally arrested, or fatal injuries may be inflicted upon the fœtus by the pressure of the points of the forceps against the abdominal viscera. Miles,* to obviate these drawbacks, has devised a pair of breech forceps, apparently well designed for seizing the pelvic extremity. As, however, a forceps of special construction is likely to be but rarely at the disposition of the physician when an emergency calls for action, it is not without interest to know how far the ordinary instrument is available in practice. Omitting earlier authorities, we find in modern times Jacquemier declaring that "it is inexact to state that the forceps would crush the pelvic bones, and inevitably kill the fœtus by bruising and lacerating the abdominal viscera." Tarnier stated, in his famous article on the forceps, published in the Dictionnaire de médecine et de chirurgie, 1872, that, under exceptional circumstances, neither Stoltz nor Dubois feared to apply the forceps to the breech, and added that he had a number of times imitated their practice with success for the mother, and sometimes for the child. When the fœtus was dead, he assured himself at the autopsy that the forceps had produced no lesion either of the pelvis or of

* Miles, The Forceps in Difficult Breech Presentations, Am. Jour. Obst., vol. xii, p. 135, New York, 1879.

the abdominal viscera. Hüter, in his excellent treatise on Obstetrical Operations (Leipsic, 1874), declares that no better instrument exists for the extraction of the breech. Dr. Henry Fruitnight, of New York city, published in July, 1877, in the Virginia Medical Monthly, a successful case where the forceps were used at the suggestion of Dr. E. C. Harwood. Dr. I. E. Taylor has applied the forceps to the breech six times with success. In 1877 Haake* published five cases in which, as he says, to the astonishment of the physicians present, the extraction with the forceps was easily and quickly ended without detriment to the fœtus. In the same year Agnew reported two successful cases to the London Obstetrical Society. I once saw, in consultation with Dr. F. A. Castle, a case of breech presentation in a primipara past her thirtieth year, where, after ineffectual essays at manual extraction, I applied the forceps over the sacrum and the anterior surface of the

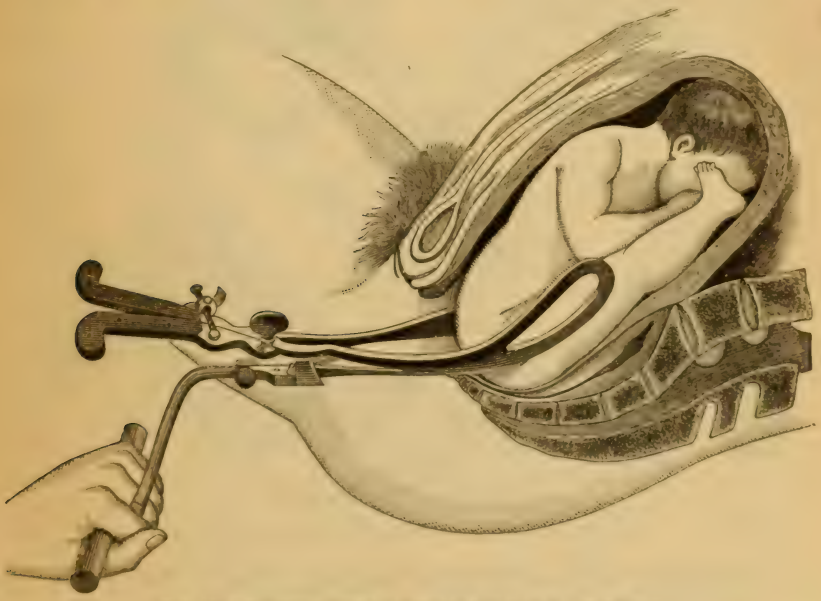


Fig. 162.—Tarnier forceps applied to the thighs. (Ollivier.)

thigh. Though the breech had not completed its descent through the cervical canal, and the parts were rigid, the child was easily extracted in about fifteen minutes. The child was alive, and the trifling pressure-marks disappeared in a few days. Recently I have had occasion to apply the forceps to the breech in the case of an elderly primipara, where the rigidity of the soft parts was extreme. The operation occupied nearly an hour. The patient suffered no inconvenience, and only

* Haake, Ueber den Gebrauch der Kopfzange zur Extraction des Steisses, Arch. f. Gynæk., vol. xi, p. 558, Berlin, 1877.

a slight abrasion was found upon the thigh of the child, which was born living. Dr. Harvey, Professor of Midwifery in the Medical College of Bengal, in an essay (1884), reports six cases. In three out of six the success was complete, in one the forceps was without avail, while in the other two, although the instrument slipped, it did not do so until it had brought down the breech, so as to allow him in one case to get his fingers over the groin, and in the other to apply the fillet, which he had previously failed to do.

Since the invention of axis traction by Tarnier a new impetus has been given to the method. With axis traction, not only is the resistance offered by the parturient canal diminished, but, as Pinard states, the pressure is regulated, and is not increased by traction. The fetal

Fig. 163.—The fillet in dorso-anterior position. (Ollivier.)

part is seized solidly, and with the least risk of harm. Ollivier reports successes with Tarnier's latest model in his own practice, and in that of Budin, Thomas, Berthout, Lobat, and Cayla.

Thus it will be seen that the weight of experience is favorable to the forceps as a breech-tractor, while the objections are mainly theoretical. The instrument is inadmissible so long as the breech does not engage in the pelvic cavity. Haake limited its use to cases in which the breech was already at the pelvic outlet, and only after complete rotation had taken place. With axis-traction forceps the indication is certainly extended, as a rule, to all cases where the breech has passed the pelvic brim and the dilatation of the os is well advanced. If rotation has taken place, the blades should be applied, respectively, over the

sacrum and over the posterior surface of the thigh, as recommended by Haake. If the hips are transverse, Ollivier advises that the blades be applied to the lateral surfaces of the thighs. The application of the blades over the trochanters, with the extremities overlapping the crests of the ilia, is to be deprecated, as the ilia are compressible and allow the forceps to slip (Ollivier). The extraction of the child should not be made an exhibition of strength. The rigidity of the maternal structures is rarely to be overcome by any justifiable degree of force. The slow descent of the breech, effected by intermittent traction, best insures the physiological softening of the tissues in advance of the presenting part. As the genital canal softens and relaxes, but little force

FIG. 164.—The fillet in dorso-posterior position. (Ollivier.)

is required to effect the birth of the breech. The tractions are most effective if made during the pains. They should be aided by simultaneous pressure exerted by an assistant upon the fundus of the uterus.

If the forceps fails, or, owing to the non-engagement of the breech, is contra-indicated and an extremity can not be brought down without the employment of force, a resort to the fillet is admissible. The objections urged to its use are: 1. That the fillet is apt to become twisted, and that, when moistened with the vaginal secretions, it may form an uneven band, which, even with care, is capable of cutting deeply into the tissues; 2. That in some cases it causes partial extension of the extremity, and, as a consequence, slips forward upon the thigh, whence

fracture of the thigh-bone becomes inevitable. The reports from the Lying-in Institution of Munich, where, owing to the advocacy of Hecker, the fillet has been assiduously tested, do not confirm the idea that these accidents are of necessary occurrence. Thus, in the last report of Von Weckberger Sternefeld, the records of thirty cases—twenty-one primiparæ and nine pluriparæ—are given. The mothers all did well. One of the children was in a macerated condition when the fillet was employed. Of the remaining thirty, twenty-four were born living. Of these, eight were partially asphyxiated, but seven were revived. In no one of the children born dead was the result attributable to the method of extraction employed. Twenty-three of the children left the institution in a healthy condition. In four cases, deep pressure-marks, but without excoriation, resulted from the use of the fillet. In the others, either no traces of pressure were found or they were of an insignificant nature. In all, the marks had disappeared in a few days. In one instance only fracture of the thigh occurred. The back was turned to the right and to the rear. Ollivier has shown that it is in dorso-posterior positions that especial caution is called for when traction is made at the groin. A glance at Fig. 164 will show that it is not easy in these cases to direct the tractions in such a way as to avoid the partial extension of the thigh and the transfer of the pressure to the shaft of the thigh-bone. This extension, Ollivier suggests, can be prevented by passing the fingers into the rectum and pressing the breech forward as tractions are made. The fillet should be passed over the anterior thigh, the tractions should be of moderate force, they should be made during the pains, and should be sustained by external pressure made by a skilled assistant.

The passage of the fillet around the groin by the finger alone is by no means always easy in the class of cases in which the fillet is principally indicated, viz., in those where the breech is high and difficult of access. To be sure, with patience the knotted end of a handkerchief can sometimes be pushed around the groin, or, failing in this, an elastic catheter with a loop attached to the extremity may be guided by a finger in the groin down between the thighs, to serve as a means of conducting the fillet into position.

Many ingenious instruments have been especially devised to serve as porte-fillets. Of these, Ollivier's instruments, modified by him from an invention of Tarnier, will serve as an example. It consists of a long-handled blunt hook, with a central tunnel and a terminal olive-shaped bulb. Through the central canal a long piece of whalebone is passed. The extremity of the whalebone terminates in a metallic eye, which occupies, when the whalebone is withdrawn, a hollow space in the olive-shaped extremity of the blunt hook. Below the handle the end of the whalebone is armed with a button, to prevent it from being accidentally withdrawn into the canal. A screw above the handle serves to fix the bone at any point deemed desirable. The blunt hook is adjusted by passing it upward along the side of the child, directed to the front to a point above the pelvis, and then directing the curve so as to adjust it to the groin. The whalebone is then easily pushed forward until it is felt by the fingers of

the physician between the thighs of the fœtus. The metallic eye is next directed by the fingers outside of the vulva. The attached fillet is easily withdrawn by reversing the directions given.

The fillet employed may be of any material. In emergencies the nearest object can be made to serve. It is desirable that the fillet should be adjusted

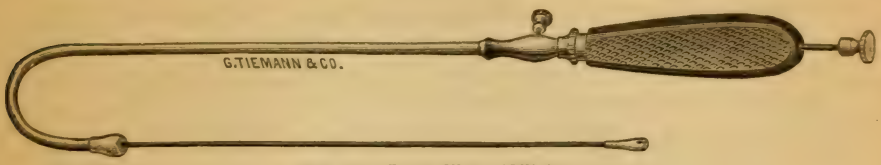


Fig. 165.—Porte-fillet. (Ollivier.)

without forming folds or creases. Ollivier recommends passing a lacing through a piece of rubber tubing the size of the little finger. The lacing should be fixed by stitches to the ends of the tube, a projecting portion serving to attach the tube to the eye at the end of the whalebone. In Ollivier's experiments the rubber tubing acted admirably in protecting the tissues of the child from harmful pressure.

In the absence of other appliances, or should failure attend the measures already described, it is well to remember that the blunt hook owes its sinister reputation not so much to its inherent defects as to lack of proper caution in its employment. It will not break the femur if adjusted in the groin. It will not produce serious contusions if the blunt end is carefully guarded by the finger. Injuries to the maternal tissues can only occur where leverage movements are made. So long as the pressure of the curved portion is confined to the groin, serious lesions are not likely to be produced. Steady downward tractions, made with moderate force and with a hand in the vagina to guard the point of the instrument, and to give warning of commencing extension of the thigh, will in the rule suffice to prevent serious accidents.

No instrument is capable of seizing the breech so securely as the cephalotribe. If, therefore, the child be dead—a fact rarely to be determined except in cases where the cord can be reached—the cephalotribe, screwed tightly to the breech, can be trusted to act as a reliable tractor.

Management of the Cord.—So soon as the cord has passed beyond the vulva, dragging upon the navel should be avoided by gently pulling the cord downward into one of the recesses to the sides of the promontory until some resistance is experienced. Sometimes the cord is found passing between the child's legs and up over its back to the placenta. Then traction should be exerted upon the placental extremity, and an attempt made to slip the loop over the posterior thigh. In the rare cases of failure to obtain its release, and where the cord is wound around the child's body, either two ligatures or compression

forceps should be applied, and the cord be divided between them, whereupon every effort should be put forth to complete the delivery as speedily as possible.

Second Act: Liberation of the Arms.

When the Arms are flexed upon the Thorax.—After providing for the safety of the cord, the pelvis of the child should be seized in the two hands with the thumbs upon the sacrum. Traction should be employed in a downward direction until the shoulder-blades make their appearance. Then no time should be lost in liberating the arms. If the latter are folded upon the chest, delivery is an easy matter. The palmar surface of the corresponding hand is passed over the belly of the child to the posterior arm (back to the right, right hand, and *vice versa*), while the extremities, wrapped in a warm cloth, are drawn in the opposite direction. The forearm should be seized as near the wrist as possible, and be brought down over the abdomen to the side of the child.

When the Arms are extended.—Unless, however, great care has been exerted during extraction to keep the uterus by external pressure closely in contact with the fœtus, the friction of the parturient canal is apt to brush one or both arms upward to the sides of the child's head. In such cases the difficulties involved in liberating the arms are often very great. Here, too, owing to the increased amount of space afforded by the curvature of the sacrum, an attempt should first be made to release the posterior arm.

Release of the Posterior Arm.—This is best accomplished by drawing the lower extremities strongly upward and to the side, thereby causing the posterior shoulder to sink deeper in the pelvis and to furnish more room for the introduction of the hand; then two fingers should be passed along the side of the child to the elbow-joint, which should be pushed across the face, and be brought down over the thorax.

In case the foregoing manœuvre can not be rapidly executed, the operating hand may be removed, and the extremities of the child may be drawn in the opposite direction, while the hand which at first had seized the feet or breech should pass upward over the abdominal surface to the posterior elbow. The latter should then be directed forward, by means of two fingers in the joint, toward the anterior pelvic wall.

Whether the hand be passed behind or in front of the child, it should be introduced slowly and without force during the intermission between the pains. Pressure should always be made at the joint, and never upon the humerus. A forgetfulness of the latter rule is apt to produce fracture.

Release of the Anterior Arm.—As there is rarely space enough be-

tween the symphysis and the shoulder to allow the fingers to reach the elbow, it is customary after release of the posterior arm to rotate the trunk so as to bring the anterior arm backward into the cavity of the sacrum. This is accomplished with the least disturbance of the normal mechanism by seizing the released arm and drawing it upward on the dorsal side of the child. The shoulders readily follow the movement until the half-circle rotation is completed.

Exceptional Cases.—The shoulders, in place of rotating into the conjugate diameter, may enter transversely into the pelvis. If the back then be turned toward the symphysis, the hand should be passed over the abdominal surface in search of the arms. The space opposite the sacrum renders this movement one of easy execution. When the back is turned to the rear, so long as the arms are flexed, the hand should search for them under the symphysis pubis. If, however, they are extended upon the sides of the child's head, it is rarely possible to push the arms forward between the face and the symphysis pubis. An effort should be made, therefore, to bring one arm to the rear by rotating the thorax with the hands. Michaelis succeeded twice in similar cases without rotating the trunk, by passing the hand behind the dorsal surface of the child and drawing the elbow backward and downward below the side-wall of the pelvis, and then pushing the forearm over the thorax.* I have repeatedly tested this movement in passing the cadaver of an infant through a bony pelvis, and find that it can be accomplished without producing fracture or dislocation. Of course, during the life of the child the result may be different.

Sometimes, in rotating the shoulders, the anterior arm becomes displaced backward, so that the forearm is thrown across the neck of the child. When this accident is of recent occurrence, the release of the arm may be accomplished by pressing the thorax of the child backward into the genital passage, and rotating the body in the reverse direction from that which produced the difficulty. If, however, tractions have been made upon the child until the head has entered the pelvis, the arm may become so compressed between the neck and the symphysis pubis as to render its liberation a very difficult if not impossible task. Then every resource should be quickly tested to turn the shoulder of the displaced arm to the rear, either by raising the released arm, or by rotating the thorax, or by drawing upon the elbow. In case of failure to obtain a speedy result, extraction may be attempted without releasing the arm. To be sure, fracture of the humerus is thereby rendered highly probable; but if the bystanders are forewarned that the risk is incurred in the interest of the child, they are generally ready, where the life of the latter is preserved, to condone the injury.

In setting a fractured arm, soft pads should be bandaged upon the

* Michaelis, Abhandlungen, Kiel, 1833, p. 230.

anterior and posterior surface to hold the extremities in position. The posterior pad should run the entire length of the arm; the anterior pad need not extend below the elbow. The arm should then be bandaged to the thorax. In two or three weeks consolidation takes place.*

In performing artificial rotation, it is well to bear the warning of Dr. Barnes in mind, viz., "That the atlas forms with the axis a rotatory joint, so constructed that, if the movement of rotation of the head be carried beyond a quarter of a circle, the articulating surfaces part immediately, and the spinal cord is compressed or torn."† Pains should accordingly be taken to note, when a half-turn is given to the body, whether the head follows the movements of the trunk.

Third Act: Extraction of the Head.

In the extraction of the head we have to distinguish—1. Cases in which the head has entered the pelvis, and has only to overcome the resistance of the perinæum; 2. Cases where the head is retained at the brim by pelvic contraction, stricture of the os uteri, extension of the chin, or insufficient expulsive action exerted by the uterus and the abdominal muscles.

1. Extraction of the Head after it has entered the Pelvis. Smellie's Method.—In the so-called Smellie's method the trunk of the child is wrapped in a warm napkin and placed astride the operator's arm; the hand is then passed into the vagina, and the index and middle fingers are placed upon the fossæ caninæ to the sides of the child's nose. At the same time, upward pressure is made with the fingers of the other hand upon the occiput. By this means flexion of the head is induced. Then by raising the trunk the face is rolled out over the perinæum. This method possesses the advantage of avoiding the risks of injuring the child which are incident to the other procedures. It requires for its successful performance the completion of rotation, a small head, and a lax perinæum.

Combined Traction upon the Chin and Shoulders.—In case the foregoing plan is not followed by immediate success, the two fingers upon the fossæ caninæ should be introduced into the mouth, and the index and middle fingers of the other hand should be forked upon the shoulders. Tractions should be made somewhat downward, until the neck has been drawn below the pubic arch and the chin has reached the coccyx. Then, with occiput resting against the pubic walls, by a deliberate joint movement of the two arms the body should be raised, and the face and brow be made to rotate over the coccyx and perinæum. By this method there is obtained the greatest amount of traction force in combination with the least degree of violence to the child. As the power is exerted chiefly upon the shoulders, the fingers in the mouth are not likely to

* Spiegelberg, Lehrbuch, etc., p. 809.

† Barnes, Obst. Operations, Am. ed., p. 210.

fracture the jaw, but by keeping the chin flexed and drawing gently upon it, the danger of twisting the neck, in cases where the rotation of the face into the hollow of the sacrum is incomplete, is avoided.*

FIG. 166.—Combined traction upon mouth and shoulders. (Farabœuf and Varnier.)

When the occiput is turned into the hollow of the sacrum, and the forehead is pressed against the symphysis, the process just described should be reversed. As the fingers are forked over the shoulders, the back of the child should rest upon the arm. With one or two fingers

* The combined traction upon the chin and shoulders is in Germany known as the Smellie-Veit modified method, the latter having warmly advocated the measure in 1863. In a historical discussion of the subject Litzmann shows that, as regards priority of description, the credit properly belongs to Mauriceau.

of the other hand the chin should be flexed. Tractions should be made downward, so that while the neck rests upon the perinæum the forehead rotates under the symphysis pubis.

Ordinarily, when the head enters the pelvis in a transverse direction, the occiput rotates to the symphysis pubis during extraction. Should the head, however, remain with its long diameter in the transverse diameter of the pelvis, a hand introduced into the vagina, with the back to the sacrum and the fingers over the child's face, may sometimes be successfully employed to rotate the latter into the sacral concavity.

Fig. 167.—The method of extraction by the Prague method.

2. **Extraction with the Head at the Brim.**—With the head at the brim, the combined method as given above is available in all ordinary emergencies. As, however, the life of the child depends upon the speedy extraction of the head, it is well to become familiar with the various procedures, as, by passing rapidly from one to another, a successful result is often obtained, when failure might have followed ineffectual efforts in a single direction.

The Prague Method owes its modern name to the advocacy of Kiwisch, Scanzoni, and Lange, all representatives of the Prague school. It was, however, nearly a century earlier described by Pugh. It consists in seizing the feet with one hand, and directing the body of the child nearly vertically downward. The fingers of the other hand are hooked over the shoulders of the child, so that the tips rest upon the supra-clavicular region. Traction is exerted by both hands simultaneously. In the absence of pains, external pressure upon the head should be made by an assistant through the abdominal walls. Care should be taken to avoid twisting the neck, and to preserve the normal relations between the head and the shoulders. After the head has passed the brim and fairly entered the pelvis, the hand upon the neck is employed as a fulcrum, while the extremities are raised rapidly toward the abdomen of the mother; the friction from the inner surface of the symphysis pushes the occiput upward, and forces the face to de-

scend into the hollow of the sacrum and to sweep over the perinæum.

When the chin is directed to the front, and at the same time is arrested at the symphysis pubis, if the occiput occupies the hollow of

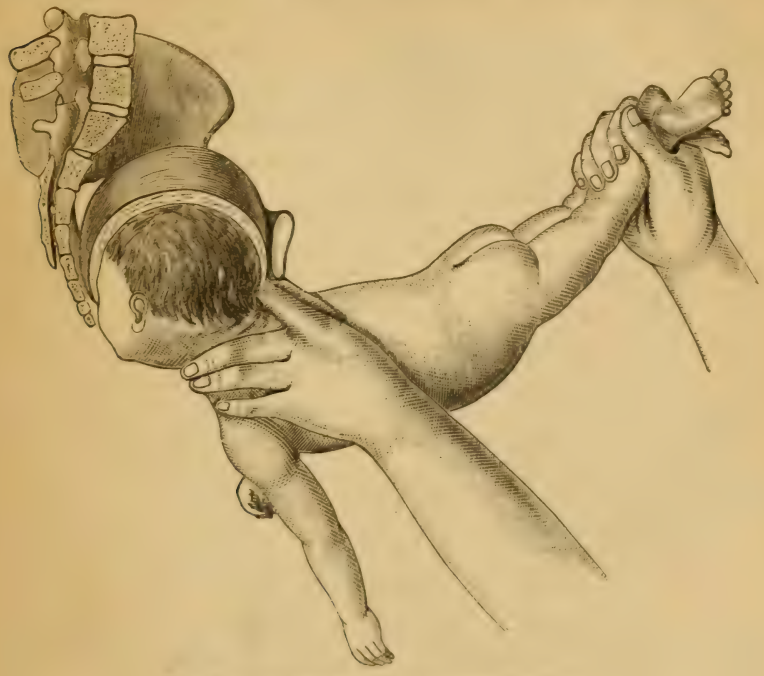


Fig. 168.—The Prague method of extracting head.

the sacrum, the body of the child should, during the tractions, be directed toward the abdomen of the mother, so as to cause the occiput to rotate over the perinæum.

The so-called Prague method is particularly serviceable in cases of flattened pelvis, in which the chin normally is partially extended as the head engages in the sagittal diameter of the brim.

Forceps to the After-coming Head.—The forceps to the after-coming head has been condemned by some and warmly approved by others. As, however, with its aid I have in a number of instances extracted children alive in cases where the foregoing methods have failed me, it is now my custom to have the blades duly warmed and ready to hand before attempting manual extraction. The instrument is occasionally of use in overcoming the resistance of a rigid perinæum in strongly built primiparæ, but is chiefly indicated when both occiput and chin are arrested at the superior strait. With the chin anterior, the forceps should be applied under the back of the child, and the handles raised so as to bring the occiput into the hollow of the sacrum. With the

chin to the rear, the forceps should be applied under the abdomen, and be used to draw the face into the sacrum. Where the arrest of the head is due to stricture of the os externum or internum, the forceps will sometimes bring the head rapidly through the cervix, when traction upon the feet only serves to drag the uterus to the vulva. In stricture of the cervix, however, great care must be exercised to avoid laceration, as under no circumstances are extensive ruptures of the lower uterine segment so apt to follow as in the forcible extraction of the after-coming head. Should this happen, the writer urgently

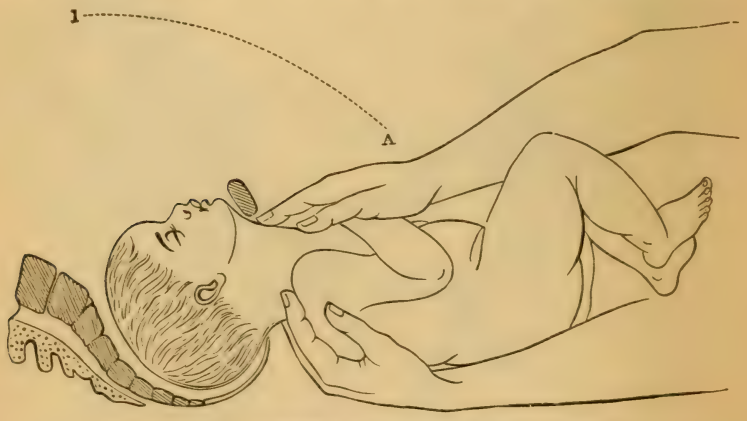


FIG. 169.—Chin arrested at symphysis. (Chailly-Honoré.)

counsels the immediate employment of the suture, as the dangers of childbed are thereby diminished, and much immediate and prospective suffering are prevented. The introduction of a large-sized catheter into the child's mouth and drawing back the perinæum have been found useful as temporary means of introducing air into the child's lungs, where delay attends efforts at delivery.

In extracting the after-coming head, the axis-traction forceps is particularly serviceable.

CHAPTER XXI.

VERSION.

Cephalic version.—External method.—Combined method.—Busch.—D'Outrepont.—Wright.—Hohl.—Braxton Hicks.—Podalic version.—Bipolar method.—Internal version.—Neglected version.—Use of the fillet.

VERSION, or turning, is the term employed for the operations by means of which an artificial change is effected in the presentation of the child. It comprises the substitution of one pole of the fœtus for

the other, and the conversion of an oblique or shoulder presentation into one in which the long axis of the fœtus corresponds to the vertical axis of the uterus.

It is customary to designate specifically the character of the version by mentioning—1. The presentation to be changed. Thus, version is made from the head, the breech, or the shoulder, as the presenting part. 2. The presentation to be effected. The term cephalic version is used where the head is brought to the brim of the pelvis, and podalic version where the feet are seized and the extremities made the presenting part. 3. The method adopted by which version is accomplished. The expression external version is applied to manipulations exclusively through the abdominal walls; internal version, to the introduction of the entire hand into the uterus; and the combined method to cases in which both hands, the one externally and the other with two to four fingers introduced through the os, co-operate together.

Cephalic Version.—When it is simply required to rectify a faulty presentation (shoulder or transverse), without reference to modifying circumstances, cephalic version unquestionably deserves the preference. In practice, however, this method requires the concurrence of so many favorable conditions that its employment is very limited. For instance, there must be no complications which call for rapid delivery. It would be unsuitable in prolapse of the cord and in cases of placenta prævia. There should be nothing to prevent the child's head from entering the brim of the pelvis. It should, therefore, not be attempted in contracted pelves. A prolapsed arm, unless previously replaced, would render the operation impossible. The child should enjoy a considerable degree of mobility. An abundance of amniotic fluid contributes much, though it is not indispensable, to success, as, even after the rupture of the membranes, provided the uterine walls are sufficiently relaxed, the head may be brought into the pelvis. Before rupture, excessive sensitiveness to manipulations, and, after rupture, rigidity of the uterus, stand in the way of success.

The operation may be performed by either the external or the combined method.

Of the external methods the best is that which is known as Wigand's (1807), which combines a suitable position of the mother with manipulations through the abdominal walls. The mother is at first made to lie upon her back, with knees flexed, and with the abdomen exposed or covered by some light material. The physician stands by the side of the patient, looking in the direction of her face. He begins by laying his hands flat upon the surface of the abdomen, and seeks with the one the head and with the other the breech of the fœtus. During the intervals of the pains, by gentle movements of the two hands working simultaneously, he strives to press up the breech and anterior surface of the child and to bring the head into the pelvic

brim. Should the uterus harden, all friction movements of the hands should cease, and the efforts of the operator be confined to holding the fœtus steady in the position previously produced. The movement may be aided by turning the woman upon the side toward which the head is directed. As the fundus of the uterus sinks to the side upon which the woman lies, it carries the breech of the child with it, while the change in the uterine axis tends to throw the cephalic end in the opposite direction.

When the head is once brought to the brim of the pelvis it may be retained *in situ*, if the patient lies upon her side, by the hand of an assistant, or by a small, hard pillow pressed firmly against it. If the patient lies upon the back, two compresses may be laid along the sides of the uterus near the head, and a bandage applied to the abdomen to keep them in position. When the pains are regular and the cervix partially dilated, fixation of the head may be accomplished by rupturing the membranes and allowing the waters to escape. Until the uterus retracts down upon the child, the head should be held at the brim either by the two hands through the abdominal walls, or by the thumb and four fingers of one hand applied directly to the head through the cervix.

The more important of the combined methods are those of Busch, D'Outrepont, Wright, Hohl, and Braxton Hicks. They have in com-

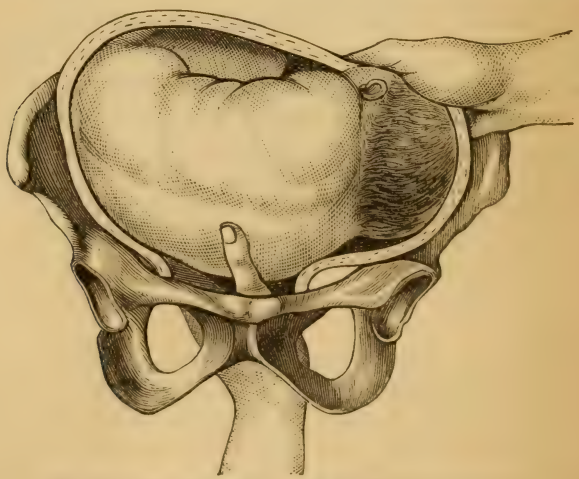


FIG. 170.—D'Outrepont's method, modified by Scanzoni.

mon the simultaneous employment of the external and internal hand. They differ, however, in detail. The methods of Busch and D'Outrepont have now chiefly an historical interest. Busch introduced the hand corresponding to the child's head through the vagina and cervix, while counter-pressure was made with the other hand upon the fundus

uteri. The back of the hand is at first directed to the front. When, however, its widest portion has passed above the symphysis pubis, the back of the hand is turned to the concavity of the sacrum, and the fingers are pushed up with care between the membranes and the uterus to the head. The membranes are then ruptured, and during the escape of the waters the head is seized by the fingers and thumb and drawn into the pelvis, while the disengaged hand presses the breech toward the median line. Every pains should be taken to prevent, with the fingers, the prolapse of the cord, or of an arm,* during the escape of the water. D'Outrepont seized the presenting shoulder between the thumb and fingers of the hand corresponding to the breech, and, during the intervals between the pains, pushed the shoulder upward and in the direction of the breech until the head descended into the pelvis. During this manœuvre D'Outrepont simply used the external hand to support the uterus. Scanzoni recommended that it should be employed externally to press the head toward the pelvic brim.†

Wright's method differs from that of D'Outrepont, in that he employed, to seize the shoulder, the hand corresponding to the head, and while he pushed the shoulder, without lifting, in the direction of the curve of the uterus, he applied the remaining hand to dislodge the breech, and move it toward the center of the uterine cavity.‡

All the foregoing methods require for their successful performance a movable fœtus and a dilated cervix—conditions which render podalic version safe and of easy execution. In practice, therefore, they have never enjoyed any considerable degree of popularity. Of far greater importance are the methods of Hohl and Braxton Hicks, which, possessing the advantage of requiring the introduction of two fingers only into the uterus, can consequently be resorted to at an early stage of labor. Hohl, like Wright, employed for internal use the hand corresponding to the head. With two fingers in the cervix, he pushed the top of the shoulder in the direction of the breech, and pressed the head into the pelvis with the external hand. At the same time he intrusted to an assistant the task of seizing the fundus of the uterus between the palms of the hands, and directing it to the side toward which the head was originally turned.# Braxton Hicks describes his method as follows: "Introduce the left hand into the vagina as in podalic version; place the right hand on the outside of the abdomen, in order to make out the position of the fœtus and the direction of the head and feet. Should the shoulder, for instance, present, then push it, with one or two fingers on the top, in the direction of the feet. At the same time pressure by the outer hand should be exerted upon the cephalic end of the child. This will bring down the head close to the

* Scanzoni, Lehrbuch der Geburtshülfe, 1867, Bd. iii, p. 63. † *Op. cit.*, p. 65.

‡ Wright, Am. Jour. of Obstet., vol. vi, part 1, 1873.

Hohl, Lehrbuch der Geburtshülfe, 2te Auflage, 1862, p. 784.

os; then let the head be received upon the tips of the inside fingers. The head will play like a ball between the hands, and can be placed in almost any part at will. . . . It is as well, if the breech will not rise to the fundus readily after the head is fairly in the os, to withdraw the hand from the vagina and with it press up the breech from the exterior." * Lately, Hicks has proposed to employ the external hand to alternately press the head into the os and the breech to the fundus. His plan differs from that of Hohl, in that he operates with the patient upon the side, and uses the left hand with the patient upon the left side, and the right hand when she lies upon the right. He likewise dispenses with an assistant.†

Podalic Version.—Podalic version is indicated in the following cases:

1. The transverse presentation, where cephalic version is contraindicated, or attended with any considerable degree of difficulty.

2. In head presentations, where there is reason to suppose that the result would be favorably influenced by bringing down the feet. As illustrations of such conditions, we have faulty presentations of the head and face, prolapse of the cord and extremities, placenta prævia, and contracted pelvis. The various contingencies which call for version will be more closely considered in connection with the special morbid conditions mentioned.

The operation may be performed by combined external and internal manipulations, or by the internal hand alone.

The Bipolar or Combined Method of Braxton Hicks.—In the bipolar method of turning, the two hands operate simultaneously upon the extremities of the fœtus. It may be carried out at will with the patient upon the side or upon the back. The latter position is the one which finds most favor in this country. The patient should be placed transversely in the bed and the nates drawn to the edge. Two assistants are required to hold the legs, which should be flexed and rotated outward. As the beds in America are very low, where difficulty in operating is anticipated it is sometimes advisable to remove the patient after she has been anæsthetized to a table covered with a blanket or woolen comforter. Complete anæsthesia is useful as a means of facilitating the introduction of the internal hand, and maintaining a relaxed condition of the uterus. Care should be taken that both bladder and rectum are emptied. The hand selected for internal manipulations should be of the same name as the side to which the extremities are turned—i. e., feet to the right, right hand; feet to the left, left hand.‡ The fingers should be brought together in the

* Hicks, Combined External and Internal Version, Trans. of the Obstet. Soc. of London, vol. v, p. 230.

† Hicks, Am. Jour. of Obstet., July, 1879, p. 593.

‡ In England the patient is delivered upon the left side, and the left hand is commonly introduced into the vagina. In Germany, when the patient lies upon the

form of a cone. The back of the hand and forearm should be well lubricated with oil or lard. In passing the hand into the vagina, the labia should be separated by the thumb and fingers of the disengaged hand. Entrance is effected by directing the fingers toward the sacrum, and pressing backward upon the distensible perinæum. In this stage of the procedure hasty action is out of place. Patience and gentleness are the prime requisites. Two or three fingers only need to be carried through the internal os. When the presenting part is reached, the external hand should be laid upon the abdomen, and pressure brought to bear upon the breech. The two hands should then move the extremities of the child in opposite directions. To quote Dr. Barnes, "The movements by which this is effected are a combination of continuous pressure and gentle impulses or taps with the finger-tips on the head (or shoulder), and a series of half-sliding, half-pushing impulses with the palm of the hand outside." When the breech is well pressed down to the iliac fossa, the membranes should be ruptured during a pain, and a knee, which at this time is generally near the os internum, should be seized and hooked into the vagina with the fingers. As the breech is brought into the pelvis by tractions upon the leg, the outer hand should be employed to press up the head until the version is completed.

The manipulations described are to be conducted during the intervals between the pains. Care should be taken not to hook down the cord with the knee. When the lower extremities are reflected upward upon the body so that a knee is not attainable, the breech may often be brought down by a finger inserted into the fold of the thigh, or by pressure upon some part of the pelvis.

The combined method of version, which we owe in all its essential features to Braxton Hicks, is one of the most important contributions to obstetrical practice of the present century. It possesses the priceless advantages of enabling the physician to perform version early in labor, and to accomplish the operation without in any way imperiling the integrity of the uterus. The only prerequisites for success are: sufficient dilatation of the cervix to permit the passage of two fingers, a certain degree of fetal mobility within the uterine cavity, and a precise knowledge of the fetal position. After rupture of the membranes and escape of the waters, the operation becomes more difficult, but is even then not always impracticable.

Internal Version.—In internal version the entire hand is introduced into the uterus. It is necessary, therefore, that the cervix should be so far dilated that the hand can be passed without violence through the cervical canal. Irregular uterine contractions require to be relieved by hypodermic injections of morphia, with or without the addition of

right side, the left hand is employed inside; when upon the left side, the right hand. The choice of hands, it will be seen, is not a matter of considerable importance.

atropia, or by the induction of complete anæsthesia. As internal version is not an indifferent operation, but may be followed by inflammations due either to injuries of the maternal tissues or to the introduction of infected air into the uterus, it should not be attempted until the impracticability of the combined method has been demonstrated. It is applicable chiefly to cases in which a certain degree of uterine retraction has followed upon the escape of the amniotic fluid.*

Fig. 171.—Version in head presentations. (Chailly-Honoré.)

The patient should be placed upon the back or side; the bladder and rectum should be emptied; and anæsthesia should be pushed until the action of the abdominal muscles is suspended. The exact position of the fœtus should be carefully ascertained. The hand should be rendered thoroughly aseptic, and should be passed slowly, after the expiration of a pain, with the fingers formed into a cone, through the vagina and cervix, opposite the sacro-iliac synchondrosis, upon the side of the child's feet. At the same time counter-pressure should be maintained over the fundus uteri, to prevent rupture of the vaginal attachments. If the uterus begins to contract, the fingers should be spread out, and the operator remain passive until the pain subsides.

In head presentations, the hand employed should be always the one which corresponds to the side of the child's feet. In transverse presentations, when version is performed soon after the rupture of the membranes, before retraction of the uterus has taken place to any extent, the choice of hands is of little consequence. This is especially true in the dorso-anterior position. Thus, when the child lies with the head to the left, feet to the right, and belly to the rear, the right hand may

* If the membranes are intact, and internal version is chosen in place of the bipolar method, one of three plans is open in practice: 1. Boer recommended passing the hand between the membranes and uterus to the feet of the child, and then rupturing the membranes; 2. Hüter seized the feet of the child through the membranes, and turned without rupturing; 3. Levret ruptured the membranes at the os uteri, and introduced the hand during the outflow of the water. The third plan is the one most deserving of favor.

be passed directly across the belly to the extremities of the child, or the left hand may be made to pass from the breech, along the surface of the thigh, to the nearest knee or leg. By the latter method the danger of mistaking an arm for the leg is avoided. Should, in any case, doubt upon this score arise, the characteristic differences between the hand and foot should guide us to a correct diagnosis. Thus, the wrist enjoys greater mobility than the ankle, the fingers are longer than the toes, the palm is shorter than the sole, the position of the thumb is peculiar to the hand, and the pointed heel to the foot.

In the lateral position, the patient should be placed upon the side to which the child's breech is turned, with the buttocks near the edge of the bed. Here, obviously, the operator, standing in the rear of his patient, would use with the greatest facility the hand corresponding to the side upon which the woman lies (left side, right hand, and *vice versa*). In dorso-posterior positions especially, the advantages of such a selection are manifest.

In easy versions, it is correct practice to bring down one foot or knee only. When one extremity is left reflected upon the abdomen, the larger size of the breech more fully distends the cervix, and thus prepares the way for the subsequent passage of the child's head. In difficult cases, or when rapid delivery is to be effected, both feet should be seized. A single foot should be held at the ankle between the thumb and fingers. When practicable, the entire leg may be grasped with the closed hand. When it is sought to turn by both feet, the middle finger should be placed between them, while the ankles are held by the second and fourth fingers.

While in uncomplicated cases it is not a matter of great importance which extremity is selected, it is still proper to remember that, in accordance with the rule that the limb drawn upon moves forward under the symphysis, the necessary amount of rotation is less when with the feet to the rear the lower, and with the feet to the front the upper, extremity is subjected to traction.

As in the bipolar method, during the traction upon the foot the external hand should aid version by pressure upon the head made through the abdominal walls with the disengaged hand.

When, in transverse presentations, the membranes rupture, the lower arm not unfrequently becomes prolapsed into the vagina. As a rule, this complication does not embarrass version, though it may prove a hindrance to the introduction of the hand. It is a good plan, in arm presentations, to slip a noose of tape about the wrist, which serves a twofold purpose, enabling us to draw the extremity up toward the symphysis, or back against the perinæum, according as the hand is to be passed posteriorly or anteriorly, and to hold the arm to the side of the child's body during the performance of version, thus avoiding the difficulties of arm delivery in the period of extraction. Dr. F. P.

Foster, in a case where the mobility of the child was unimpeded, used the prolapsed arm as an aid to version in the following ingenious manner: The child lay with the back to the front, the head upon the right iliac fossa, and the left arm presenting. With the right hand in the vagina, he seized the arm and pushed gently upward in the di-

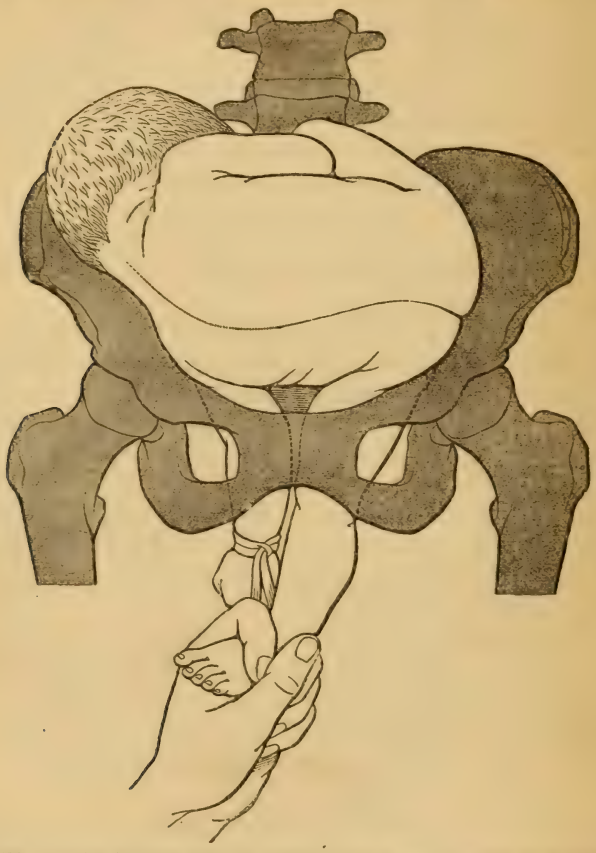


FIG. 172.—Version in dorso-anterior position, first stage. Traction on lower limb. (Farabœuf and Varnier.)

rection of the humerus. In this way he succeeded in elevating the cephalic pole until with the index-finger alone in the cervix uteri he managed to reach the breech of the child. With the point of his finger he gently urged this along to the mother's right side, and soon encountered the left foot, which he readily hooked down into the vagina.*

When, after rupture of the membranes, aid is not promptly rendered, the shoulder becomes crowded into the pelvic brim. If the

* FOSTER, On Prolapse of the Arm in Transverse Presentations, Amer. Jour. of Obstet., vol. ix, p. 203.

pains are feeble the uterus may remain relaxed, so that hours afterward version may be readily performed. If the pains are good, however, as the waters escape the uterus retracts, and finally becomes rigidly applied to the surface of the fœtus. Under these conditions, the lower uterine segment, which contains the head and shoulder of the

Fig. 173.—Version in dorso-anterior position, second stage. Traction on lower limb. (Farabœuf and Varnier.)

child, is often stretched to an extreme degree of tenuity. Version, under the circumstances, is embarrassed by the difficulty of introducing the hand into the uterus to seize the foot; by the fact that when tractions are made upon an extremity, in place of the child turning *in utero*, both child and the closely applied uterus are apt to move together; and by the danger of rupture due to the difficulty of lowering the breech without simultaneously increasing the pressure exerted upon the thinned lower segment by the child's head.

In operating after the retraction of the uterus has become complete, the physician should seek to effect the utmost relaxation by pushing anæsthesia to complete insensibility. The hand should be introduced slowly and with the utmost gentleness. Precipitate action, or an attempt to overcome the uterine resistance by force, may cause fatal rupture. The external hand should make firm counter-pressure upon the fundus, to prevent the uterus from being torn from the vagina. The seizure of the lower foot is usually alone practicable. Simpson, it is true, regarded the secret of success in such cases as depending upon

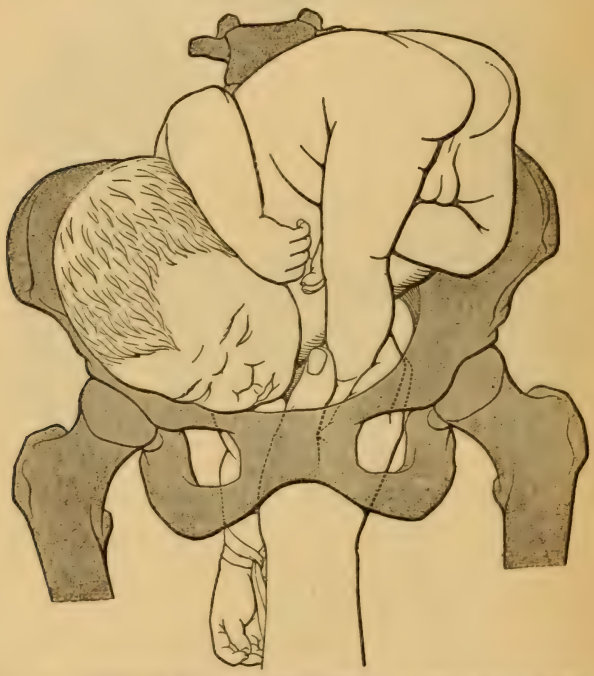


Fig. 174.—Version in dorso-posterior position. Traction on upper limb. (Farabœuf and Varnier.)

making tractions with the upper limb, as tending to rotate the body of the child upon its long axis, and thus favoring the release of the presenting shoulder from its imprisonment. However rational all this sounds in theory, rotation within a rigidly contracted uterus is easier to represent by diagram than to carry out in practice. The result of seizing the upper leg is usually to cross it with its fellow, and to twist the child's body so as to injuriously compress the abdominal viscera. By making tractions upon the lower leg, the breech is brought by the shortest route to the uterine orifice. To be sure, by this manœuvre the body of the child is bent laterally, but lateral flexion does the child no harm. In case of failure to effect version, a noose of tape may be

placed upon the foot, and the hand returned to seek the other extremity. When the foot is within reach, the loop of the fillet, placed about the fingers, is easily conveyed upward to the ankle. When, however, the foot is high up in the vagina, where the movement of the fingers is impeded, some form of instrument is needed to push the loop from the

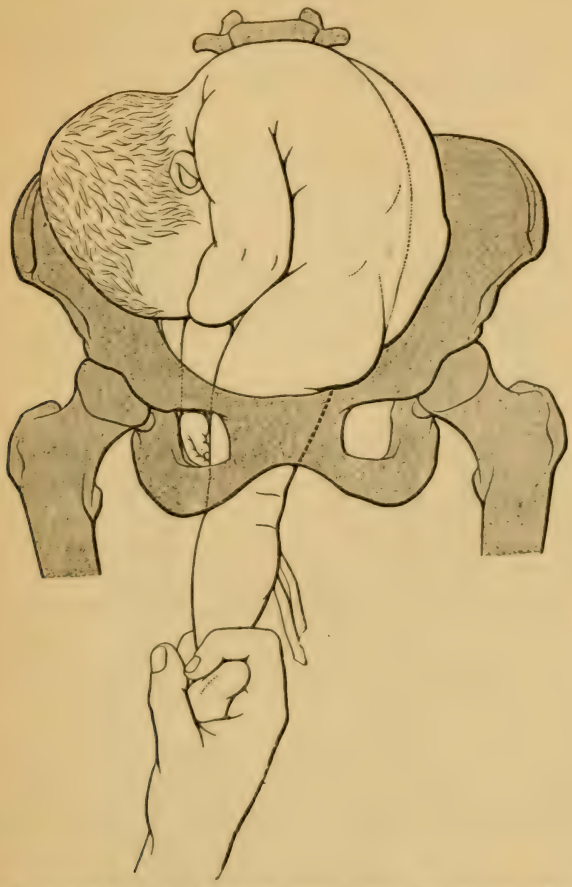


Fig. 175.—Method of seizing the foot in breech cases. (Farabœuf and Varnier.)

fingers over the foot. Unquestionably the most serviceable contrivance to this end is the repositor of Carl Braun, which consists of a gutta-percha rod sixteen inches in length, with an aperture two inches from the extremity, through which the loop of a double tape is threaded. When in use this loop is passed around the noose of the fillet, and is then reflected over the end of the rod. Thus secured, the fillet is conveyed to the position aimed at. Then, by loosening the ends of the tape, which during the upward movement are held to the sides of the

rod by the operator's hand, and by shaking the rod, the instrument is easily detached, and can be withdrawn without difficulty.

If the operator does not care to release the foot, because of the difficulties he has encountered in getting possession of it, the fillet may be noosed around his arm, and thence be pushed upward over the hand, to the seized extremity.

A device which in many instances has rendered me excellent service, has consisted of an ordinary catheter threaded with a doubled piece of twine, so that the loop projected from the eye of the instrument. This loop, after inserting the stylet into the catheter, I have used in precisely the manner laid down for the employment of Braun's instrument.

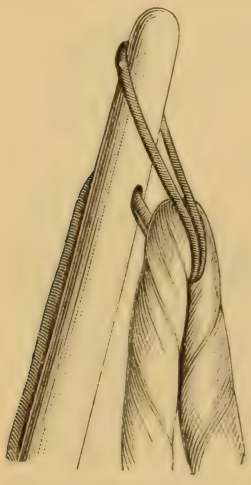


FIG. 176.—Braun's repositor.

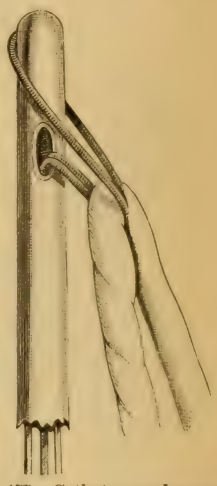


FIG. 177.—Catheter used as repositor.

In case the second limb can not be reached, or where traction upon both extremities fails to bring the breech into the cervix, an attempt should be made to dislodge and elevate the presenting shoulder. This can sometimes be accomplished, in accordance with the suggestion of Professor Goodell, by bringing down the upper arm and turning the child upon its long axis; or, while the noosed foot is held out of the way by the attached fillet, the hand corresponding to the child's head may be introduced into the vagina and employed to press the presenting part away from the cervix. The raising of the shoulder should be gradual, and should be performed with the utmost gentleness, as the danger of uterine rupture is peculiarly enhanced by the thinned, overstretched condition of the lower segment. Meantime a skilled assistant should exercise counter-pressure from without upon the fundus of the uterus and upon the head of the child, and aid the descent of the breech by rightly directed pressure. Resolution to succeed, combined

with patience in manipulation, usually overcomes the obstacles presented by the most difficult cases.

In the few instances where failure follows all attempts to accomplish version, or where rupture is imminent, or where the child is known to be dead, the obstacle to delivery may be overcome by decapitation, and the removal of the head and trunk separately.

CHAPTER XXII.

CRANIOTOMY AND EMBRYOTOMY.

Craniotomy.—Indications.—Operation.—Perforators.—Method of perforating.—Extraction after perforation.—Forceps.—Cephalotribe.—Action of the cephalotribe.—Objections.—Application of the cephalotribe.—Cranioclast.—Crotchet and blunt hook.—Cephalotomy.—Embryotomy.—Exenteration.—Decapitation.

CRANIOTOMY.

CRANIOTOMY includes all the various operations employed to reduce the dimensions of the child's head. Thus the term is applied—1. To the perforation of the skull and the evacuation of the brain-contents; and, 2. To the various procedures subsequently adopted to further minimize and extract the cranial walls.

Indications for Perforation.—Perforation is resorted to, in cases of mechanical obstacles to delivery, to overcome the disproportion existing between the child's head and the parturient canal. As the operation is performed solely in the interests of the mother, it possesses a wider range of applicability when the child is dead than when still living.

Perforation, in the dead child, is allowable in difficult labors so soon as temporizing becomes dangerous to the mother. The mere æsthetic advantage of removing by forceps an unmutilated child ought not, if attended by any risk, to be allowed to weigh with the physician against the welfare and safety of the parent.

If the child is alive, the question of perforation is one of the most serious that falls to the lot of the conscientious physician. If the life of the mother is at stake, and the sacrifice of the child is necessary to her preservation, few would dispute at the present day the superiority of the mother's claim to existence. Still, it is not sentimentality to feel that it is an awful thing to destroy a living child before a clear conviction is reached that conservative measures, which hold out the hope of preserving both lives, are of little or no avail. The proper position, however, of craniotomy, between the Cæsarean section on the one hand and forceps and version on the other, will be discussed in the section upon the treatment of contracted pelves.

Operation.—When perforation has once been decided upon, there should be no delay in its execution. By delay, the very object of its performance—viz., the preservation of the life of the mother—is imperiled.*

The patient should be placed in the usual obstetrical position, with the knees flexed and the hips drawn over the edge of the bed. Chloroform is not requisite. It is useful, however, as a means of saving the mother from painful after-memories. There is no operation in obstetrics in which the result depends so much upon thoroughness in carrying out antiseptic details. If the head is not fixed at the brim, it should be held firmly in position by the hands of an assistant, through the abdominal walls, or the child should be turned, and perforation performed on the after-coming head.

Complete dilatation of the cervix is not essential to the execution of the operation. If the object is simply to relieve the maternal soft parts from pressure, perforation may be performed at an early stage of labor. When, however, it is intended to follow perforation by immediate extraction, it is necessary to secure sufficient preliminary dilatation. In just this class of cases I have seen excellent results from the employment of Dr. I. E. Taylor's long, narrow-bladed forceps, which can be passed through a cervix dilated to scarcely an inch and a half in diameter. They enable the operator to seize the head and use it as a dilating wedge during and after a pain (*vide* p. 368). If the cervix hangs empty in the pelvis, and the head can not be moved from the brim, Barnes's dilators are often of great service. Unquestionably, in many cases less violence is done to the mother if simple perforation is resorted to, the brain evacuated, and the dilatation of the cervix left to be accomplished by the pressure of the gradually collapsing head. This method, however, exposes the mother to the dangers of septic poisoning, as, unless the pains should be good and delivery rapid, decomposition of the fœtus *in utero* speedily sets in after perforation.

Instruments employed in Perforation.—Most of the perforating instruments in use in this country are patterned, with modifications, after the scissors of Smellie. Simpson's perforator is the one I have been in the habit of employing. As compression of the handles causes the separation of the perforating points, it can be easily managed with one hand. The projecting shoulders, just beneath the cutting portions, prevent the instrument from penetrating too far into the skull. The edges and points of the blades are rounded, so that they are not liable to injure the soft parts of the mother during the operation. The

* Spiegelberg states that between the years 1870 and 1877, of thirty-three cases of perforation, three terminated fatally; while in the previous five years in which the operation was performed, at a late period, of thirteen cases, seven ended in death. (Handbuch der Geburtshülfe, p. 833.)

chief objection to the instrument arises out of these special measures of safety, as, owing to its bluntness, considerable force has to be em-

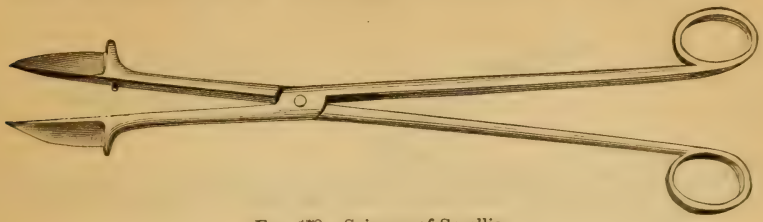


Fig. 178.—Scissors of Smellie.

ployed to penetrate the skull, which increases, of course, the risk of slipping. A better instrument is that of Monsieur Blot. It possesses

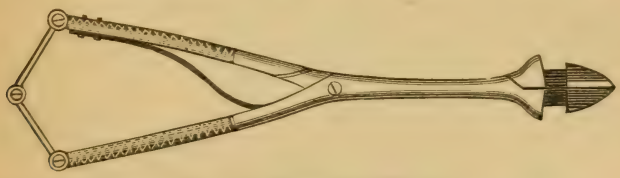


Fig. 179.—Simpson's perforator.

a spear-point, which makes it effective as a perforator. The blades, when the instrument is shut, are superimposed, and are not capable

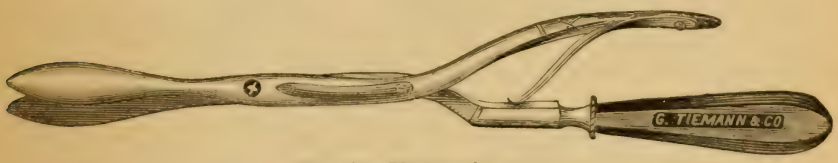


Fig. 180.—Blot's perforator.

of harming the maternal tissues. When the blades are separated, after perforation has been accomplished, they readily cut the bony structure

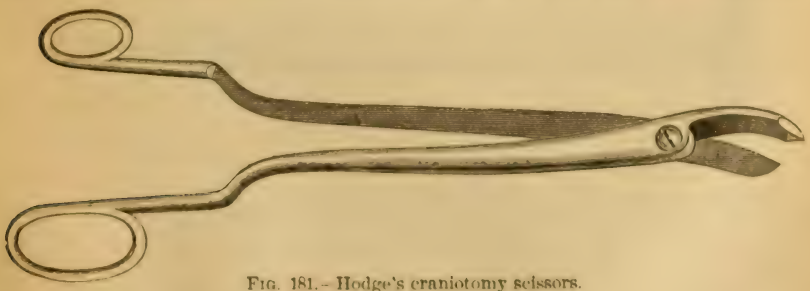


Fig. 181.—Hodge's craniotomy scissors.

of the skull. Hodge's craniotomy scissors can be used as a perforator, and afterward to cut away portions of bone. Dr. T. G. Thomas has

devised a perforator with a gimlet-like extremity, which is intended to bore its way into the skull. The opening is afterward enlarged by a knife which lies concealed and guarded in the body of the instrument

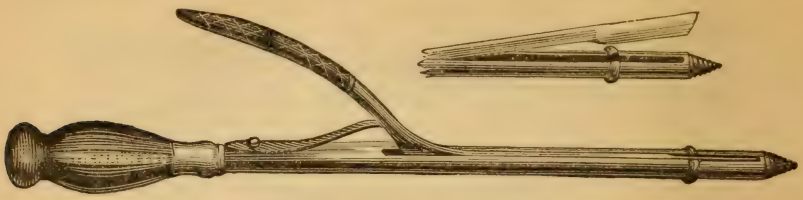


Fig. 182.—Thomas's perforator.

until required for use. Mechanically considered, Thomas's perforator is beyond reproach. It is, however, somewhat more difficult to keep in order than those previously mentioned.

The basylist of Professor Alexander Simpson resembles in its general features the perforator of Dr. Thomas. It is, however, much

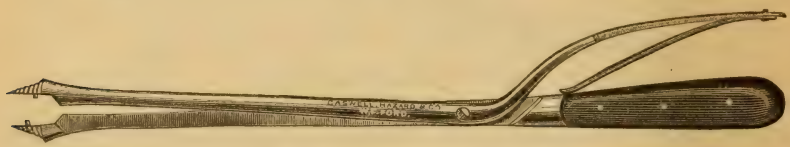


Fig. 183.—Simpson's basylist.

heavier and of more solid construction. In the place of the concealed knife it possesses two arms, which, when separated from one another, act as powerful levers. The instrument is designed not only to perforate the cranial vault, but, as its name implies, to break up the base of the skull. When this action is rendered necessary, the basylist should be pushed inward to the sphenoid bone, and a point selected for perforation in front of the sella turcica. After boring well into the

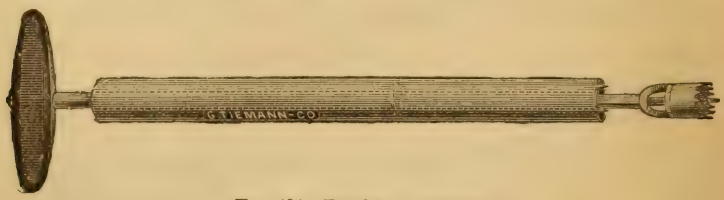


Fig. 184.—Trephine perforator.

sphenoid, the lever is used to forcibly separate the base into two portions. Ordinarily, the expulsion of the child can then be left to the natural forces.

The Germans employ for the most part a long trephining perforator, which removes circular segments from the scalp and the skull. The trephine leaves behind no splintered portions of bones, and makes

an opening which is not likely to close from overlapping; but it can, on the other hand, be used only upon the cranial vault.

Previous to practicing craniotomy the bladder and rectum should be emptied. The operator introduces his middle and index fingers into the vagina, and presses them firmly against the most accessible portion of the child's head. Great care, at this stage, should be exercised

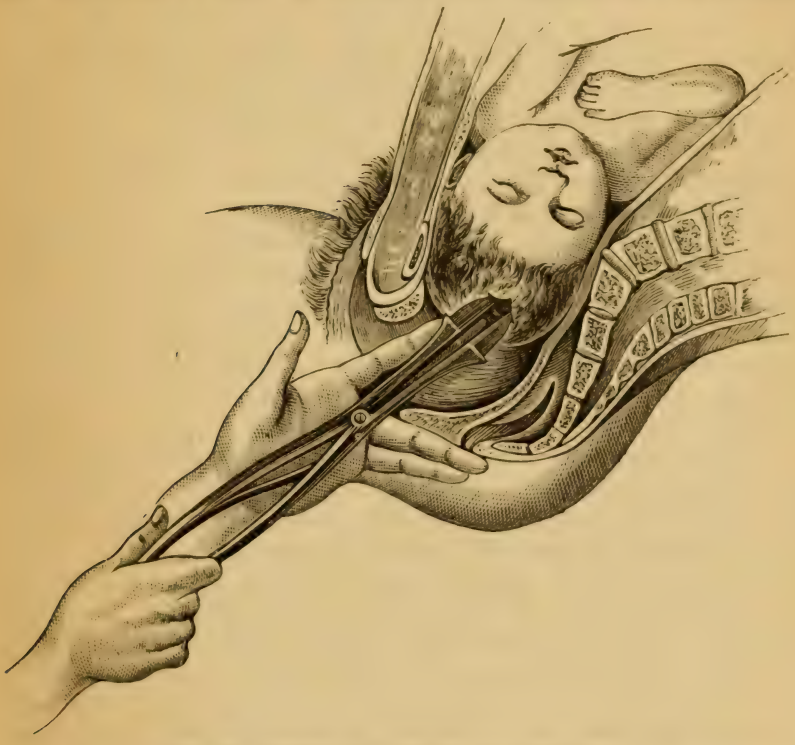


Fig. 185.—Operation for perforating the child's head.

to gain an exact idea of the situation and the extent of the dilatation of the cervix. The operator then seizes the handle of the perforator in the right hand, and passes the pointed extremity, under the guidance of the fingers of the left hand, to the region of the head at which it has been decided the perforation is to be made. If convenient, a suture or a fontanelle may be selected, in place of the bony table of the skull. The perforator should be pressed against the cranium with a boring movement until the cessation of resistance warns the operator that the bony incasement has been traversed. In cases where the skull is unusually thick or hard this part of the operation may prove a matter of some difficulty. Care should be taken to hold the instrument at right angles to the point of perforation, as otherwise it is apt to glance from the rounded surface of the head.

If the head, in place of being fixed in the pelvis, is situated high up, every precaution should be taken in the operation. The head should be pressed firmly against the brim through the abdomen by an assistant. The perforator should follow the axis of the superior strait. The point selected for perforation should be near the symphysis, as the instrument is then much less liable to slip than if carried backward toward the promontory. The fingers of the left hand should keep constant guard upon its direction. Oftentimes, by way of protection, the operator introduces the entire half-hand into the vagina. After the perforator has penetrated the skull, the opening should be enlarged by compressing the handles and separating the cutting blades; then, allowing the latter to close, the instrument should be semi-rotated, and a second cut made at right angles to the first. Before withdrawing the perforator, it should be moved about freely to break up the brain-mass. The rapidity and completeness of the collapse of the cranial walls are, in a measure, dependent upon the completeness of the evacuation of the cranial contents. Care, too, should be taken to pass the perforator into the foramen magnum to break up the medulla oblongata, and thus to insure the death of the child before delivery. Sometimes it is advantageous to wash out the brain-pulp by injecting a stream of water into the cranial cavity.*

In face presentations care should be taken to pass the perforator through the frontal bones, or through an orbit. Where neither of these points is, however, accessible, it is possible to make the opening through the roof of the mouth, behind the nasal fossæ.

The perforation of the after-coming head is always a matter of considerable difficulty. The point of the perforator has to be inserted obliquely in place of at right angles to the skull, and therefore is more liable to glance. On theoretical grounds it has been recommended to insert the instrument either between the occiput and atlas, or through a lateral fontanelle. In practice, however, such niceties are rarely observed. The operator simply passes the four fingers of the left hand under the symphysis pubis, and, while the feet of the child are drawn downward and backward by an assistant, the perforation is made at any point behind the ear at which the manipulation can be most easily effected. Chailly recommends hooking down the chin of the child, and perforating, as in face presentations, through the roof of the mouth.†

* Von Weber has shown that no cephalotribe can fully decerebrate a perforated head, in general only the small part of the brain being evacuated. He has likewise demonstrated that a greater amount of compression can be accomplished in case of a fully than a partially decerebrated head. The head, therefore, that has been fully emptied can be more easily extracted than one that has only been partially deprived of its contents.

† Cohnstein recommends cutting down upon the cervical and upper dorsal vertebræ, and then opening into the spinal canal by dividing the laminæ. Through

The trephine-perforator requires to be pressed firmly and steadily against the parietal bone. Sometimes, when a large scalp-tumor exists, it is necessary to make a preliminary incision through the integuments. The trephine is not liable to slip, and is easily managed; as it can not be used either upon the after-coming head or in face presentations, and as it is difficult to keep clean and in order, the less complicated lance-pointed instruments have, however, enjoyed the preference in all countries outside of Germany.

Extraction of the Child after Perforation. — Formerly, after perforation, a waiting policy was by many thought desirable. Osborne, indeed, recommended that at least thirty hours be allowed to elapse before delivery, in case craniotomy was performed upon a living child. The grounds for favoring a temporizing policy were found in the softening and relaxation of the sutures, and the ease with which flattening takes place after putrefaction has once set in. At present, however, it is customary to extract so soon as the condition of the os renders it safe to resort to the necessary operative procedures. This change in practice results from altered views regarding the dangers due to mere protraction of labor, to fear of septic poisoning, and finally to improved methods now at our disposal for the termination of labor. Extraction may be performed by the forceps, the cephalotribe, the cranioclast, the crotchet, or the blunt hook. In some cases version may be employed with success. Each instrument, each method, has its limitations and its range of applicability. Usually, in extreme disproportion, the operator finds it to his advantage to have at hand a complete equipment, and to resort at different stages of delivery to a succession of operative manœuvres. The acceptance of single measures and the wholesale condemnation of all others are calculated in difficult cases to lead to embarrassment and failure. A study, therefore, of the capacity of the various extractive instruments employed to deliver the perforated head is essential to the formation of correct judgment as regards practice.

Forceps.—The use of forceps as an extractive instrument, after perforation, is recommended by Tarnier as follows: "As the application of forceps has often succeeded in our hands, we do not hesitate to say that it is a good operation, applicable above all to cases in which the pelvic contraction is not considerable. The forceps possesses the advantage of being in the hands of every physician; it seizes the head firmly, and, by pressing the handles forcibly together, a sufficient evacuation of the cerebral contents is effected to secure a marked flattening of the cranial walls. In making prudent tractions, one often succeeds

the opening a silver catheter can be passed to the cranial cavity, and be used to break up the brain-mass, which should be washed out through the canal by injections of water.—(*Vide* Ein neues Perforations Verfahren, Arch. f. Gynack., Bd. vi, p. 505.)

in extracting the head without any harm to the mother; the danger begins only with too violent tractions."* These remarks apply, however, to the powerful French forceps, which is capable of exerting considerable compressive force. Hodge has found his forceps useful under similar conditions.† The short handles and the great width between the blades, in the English forceps, render it useless as a tractor when craniotomy has been performed.

Cephalotribe.—On the 6th of June, 1829, Baudelocque, *le neveu*, read before the Institut Royal de France a memoir upon a new method of performing embryotomy.‡ He first pictured the dangers incident to all operations effected with pointed and sharp-edged instruments introduced within the uterus. From the statistics of the previous sixteen and a half years in the Maternité, he showed that half the mothers thus operated upon died, and that the shortest of these operations lasted three quarters of an hour. He then described an instrument he had invented, which he termed the cephalotribe, and represented that with it he could crush in an instant the base and parietes of the fetal skull, forcing the brain from the orbits, the nostrils, and the mouth, the integuments at the same time remaining intact and forming a sort of sac, which sufficed to prevent the edges of the fractured bones from inflicting injury upon the soft parts of the mother. The author furthermore expressed his conviction that the cephalotribe was destined to abolish and replace the perforator and the crotchet, and that it could be employed successfully in pelves measuring but two inches in the contracted diameter.

This early instrument was two feet long, and weighed over seven pounds. In shape it resembled the forceps. To the handles a crank was attached, destined to approximate the enormous blades to one another. The original cephalotribe has since been subjected to various modifications, with a view chiefly to the removal of its repulsive appearance. The observation of Chailly, in his Traité pratique des accouchements, 1842, that perforation should always precede cephalotripsy, led especially to the construction of lighter and more convenient instruments. The dream of Baudelocque, that the cephalotribe was destined to abolish the perforator, has never been fulfilled.

The models in use at the present day vary considerably in weight, the extent of the pelvic and cranial curves, and the character of the apparatus for producing compression. These different varieties are simply expressions of the defective working of the instrument itself. The shape of the blades possesses the greatest importance practically. It is to be borne in mind that the cephalotribe is designed to act both as a crusher and as a tractor. Now, it so happens that whatsoever

* Tarnier, Dict. de Médecine et de Chirurgie, art. Embryotomie, vol. xii, p. 657.

† Hodge, On Compression of the Fetal Head. Am. Jour. of Obstet., May, 1875.

‡ A. Baudelocque, Revue Méd., August, 1829, p. 321.

tends to make it available in the one direction is obtainable only by the sacrifice of some corresponding advantage in the other. Thus, it is evident that the greatest amount of crushing force is exercised when the blades run nearly parallel to one another; but, without a cranial curve, the blades, in place of being applied to the convexity of the child's head, open like scissors, and thus are liable to slip, if the instrument is employed as a tractor. Again, as the blades are usually applied in the transverse or in an oblique diameter, it is necessary to rotate the cephalotribe to make the flattened head correspond to the flattened pelvic diameter. Rotation of the cephalotribe within the genital organs necessitates an instrument without pelvic curve; and, yet, where there is any considerable projection of the promonotory, a straight instrument is apt to seize the head upon its posterior aspect only, and thus the head is often forced from the blades, when compression is used, like a cherry-pit, to use Cazeaux's simile, from between the fingers.

Fig. 186 represents the French instrument of Blot, which is provided with a good pelvic curve, but the blades are in close approxima-

Fig. 186.—Cephalotribe of Blot.

tion to one another. In Scanzoni's cephalotribe, Fig. 187, the line of greatest difference between the outer surfaces of the blades is nearly two inches. The inner surface of the blades is supplied with a longi-

Fig. 187.—Cephalotribe of Scanzoni.

tudinal ridge occupying the center, while the square extremities curve sharply inward like pincers. The instrument possesses a pelvic curve of two and three quarters inches. When the Scanzoni cephalotribe is

applied to the sides of the decerebrated head, the latter lengthens in the axis of the instrument, but Mundé reports that he has witnessed the failure of the instrument to seize the head securely in the Wurzburg clinic, in three cases out of four. Fig. 188 represents a cephalo-

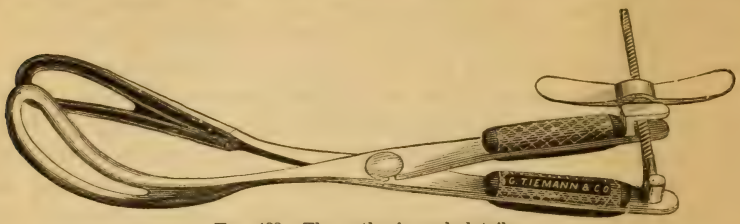


Fig. 188.—The author's cephalotribe.

tribe made for me some years ago by Messrs. Tiemann & Co., which has met with considerable favor in New York and its vicinity. It has a cephalic curve of two inches and a quarter, measuring from the outer surfaces of the blades.* The pelvic curve is three inches and two lines in extent. These measurements are similar to those of the Prague instruments of Seyfert and Breisky. The blades are fenestrated and grooved upon the inner surfaces. The advantages of an instrument thus modeled are obvious. It is possible with its aid to seize the head when movable above the pelvic brim. As the points approach each other closely after compression of the head is completed, the instrument becomes a perfect tractor, holding the head as securely as an ordinary forceps. Its construction is, however, virtually the abandonment of two favorite but chimerical ideas regarding the capacity and mode of action of the cephalotribe, viz., that it is capable of flattening the head so that the latter can be drawn through a pelvis measuring but two inches in the conjugate diameter, and that this can be accomplished by rotating the instrument, as we have mentioned, so as to make the flattened head correspond to the shortened diameter of the pelvis.

The actual result of compression by means of the cephalotribe was long a matter of dispute. Baudelocque, with his ponderous instrument, claimed to have been able to instantly crush the skull, including the base. Kilian† relates that in his first case of cephalotripsy he succeeded in breaking up the skull by a single application into fifty-four pieces. Von Weber, however, made a large number of experiments upon still-born children, employing for purposes of com-

* The advantages of making the blades parallel to one another are rather apparent than real; for, however effectively compression with such an instrument may be applied, the head acts as a wedge, producing a separation at the extremities proportioned to the absence of the cephalic curve. Breisky and Seyfert have insisted that it is better to transfer the greatest width between the blades from the extremities to the points at which they come into immediate contact with the child's head.

† Kilian, Organ f. die gesammt. Medecin, Bd. ii, p. 279.

parison instruments of various patterns, and found that in no case did he succeed in fracturing the bones of the skull. Even after the complete evacuation of the cerebral contents the bones would bend, but did not fracture. The result was different, however, in cases where the cephalotribe was employed in actual labor, where the head was subjected at the same time to pressure from the uterine and pelvic walls. Under such circumstances the bones certainly may break, if they do not invariably. Fractures he found, in fact, less common than simple incurvations. Where a fracture took place in one bone it rarely extended to contiguous ones, and, in general, contributed but little toward the actual reduction of the head. Winckel * presented three heads to the Obstetrical Society of Berlin, upon which the cephalotribe had been used to facilitate delivery. Compression, in these cases, had been employed in several diameters, and each time the cracking sound elicited could have led one to suppose that the bones were being reduced to small pieces, yet subsequent examination showed that only a single bone, and that, usually, according to the position of the head, a parietal bone, was broken to any extent, while the opposite side, generally the basis cranii, was but slightly ruptured. Now, the greatest amount of compression effected by the cephalotribe does not exceed two to two and a quarter inches. The bizygomatic diameter, indeed, which measures three inches, is not, in ordinary cephalotripsy, attacked at all.†

It has always been objected to the cephalotribe that its application in the transverse diameter increases the length of the head in the antero-posterior diameter, or precisely where the pelvis is the narrowest, and thus adds to the difficulty of delivery. This is no doubt true when the head is fixed in the pelvis, a fact which should lead us to give the preference to other instruments for extraction after engagement has taken place. Above the brim, the cephalotribe seizes the head usually in an oblique diameter, so that the compensation takes place in the opposite oblique diameter. If the head is seized in the transverse diameter, it may easily be rotated into an oblique diameter. Sometimes the compressed head rotates spontaneously, so that the cephalotribe comes to occupy the conjugate, a thing obviously possible only in moderate degrees of contraction. Artificial rotation of the cephalotribe into the conjugate is dangerous, and should under no circumstances be attempted. It must be borne in mind that the axis of the instrument is in a line between the upper border of one blade and the lower blade of the other, and not in one drawn transversely between them. If spontaneous rotation occurs, the instrument should be removed, and the cranioclast employed as a tractor. Extraction with a powerful instrument like the cephalotribe can not be safely undertaken when the points of pressure from the blades are the soft tissues between the symphysis and promontory.

Thus we find the cephalotribe useful in compressing the head before it becomes fixed at the brim. It is, moreover, advantageous as a tractor in moderate degrees of pelvic contraction. With two and three quarters inches in the conjugate, the limit for its safe employment is, as a rule, reached. Of course it is understood that other factors than the pelvic diameters may influence the result. Thus,

* Winckel, Kephalotripsie, Monatsschr. f. Geburtsk., Bd. xxi, p. 81.

† Fritsch, Der Kephalothryptor und Braun's Cranioclast, Volkmann's Samml. klin. Vortr., No. 127, p. 870.

much depends upon the size of the child's head, the resiliency of the cranial bones, and the relations of the pelvic diameters to one another. It is not disputed that the cephalotribe is capable, if force is used, of accomplishing delivery through a smaller space than the one given; but the severe injuries to the maternal tissues which the instrument is apt to inflict, even when every caution is exercised, make its employment dangerous in the higher degrees of pelvic deformity.

In 1863 Pajot * published a paper in which he stated that, while in cases of distortion in which the narrowing did not exceed two and a half inches cephalotripsy was a favorable operation, requiring the exercise of no great amount of force, and but two or three applications of the instrument, below that point he regarded it as nearly as dangerous as the Cæsarean section. In the belief that these results were due to rude attempts to drag an imperfectly reduced head through the contracted space, he proposed that in all cases below two and a half inches no tractions should be made, but, so soon as dilatation had proceeded far enough to permit, perforation should be performed, whereupon complete dilatation would occur more speedily, and cephalotripsy might be begun at an early period of labor—a point in itself of considerable importance. While applying the cephalotribe, one or two assistants should make counter-pressure over the pubes to steady the head. The blades should be introduced as high as possible by depressing the handles. After compressing the head, rotation, if it has not occurred spontaneously, should be cautiously attempted. The slightest obstacle should, however, be the signal for suspending rotation and withdrawing the instrument, when Nature usually brings about rotation with astonishing rapidity. The instrument should then be reapplied, and the compression repeated. The same process should be gone through with a third time, after which the woman should be placed in a convenient posture and given bouillon to drink. Then, governed by the state of the pulse and the general appearance of the patient, the quiet or excitement manifested, the weak or energetic character of the pains, the cephalotribe should be applied two or three times every two, three, or four hours, leaving the expulsion of the fœtus entirely to Nature. M. Pajot has never found more than four applications of this procedure necessary, while one or two have generally sufficed. After the passage of the head, one or two applications of the instrument are required, as a rule, to reduce the thorax. To be successful, however, it is requisite that the operation should be resorted to at an early period of labor, when, as a rule, not more than six to eighteen hours are needed for Nature to expel the uterine contents. Tractions should be employed only in those cases to which one is called at a late period, after the powers of Nature are exhausted. Objections to this plan of Pajot have been made as follows: That there is risk of rupture of the uterus from the prolongation of the labor; that the uterus is exposed to injury from the spiculæ at the point of perforation; that, owing to the great rapidity with which decomposition takes place after cephalotripsy, the bones of the skull are liable to become denuded of their coverings; and, finally, that after a given period the membranes become so far destroyed as no longer to protect the uterus from its decomposing contents. Pajot replies by adducing seven cases in which he employed his method. Five of the cases were successful, and two terminated

* Pajot, De la céphalotripsie répétée sans tractions, Paris, 1863.

fatally. The highest degree of deformity for which he operated was a case in which the contracted diameter was something less than an inch and a half. The patient died from ruptured uterus, due, according to M. Pajot, to attempts made previous to his arrival to perform cephalotripsy with a badly constructed instrument.

The application of the cephalotribe does not differ from that of the forceps. Where perforation has been performed, spiculæ of bone should be carefully removed with the fingers. Confirmatory evidence as to the direction of the head may be obtained by exploring the cranial cavity with the finger, as, in this way, the exact position of the base and vault may be determined. Great caution should be exercised during the introduction of the blades not to injure the vaginal or uterine tissues. It is not always easy to lock the instrument after the blades have been adjusted. The left blade is easily placed, but often the right blade is with difficulty brought forward to the corresponding transverse or oblique diameter. Compression should be made slowly, and the opening made by the perforator should be carefully guarded lest cutting portions of bone protrude. Extraction should take place under the guidance and protection of the fingers of the left hand.

Sometimes the cephalotribe is used to compress and extract the after-coming head in cases of moderate pelvic contraction. Under such circumstances perforation is usually not a prerequisite. The cephalotribe seizes the head securely, and acts with great power upon the basis cranii. The increased diameters of the head accommodate themselves more readily, too, to the long diameters of the pelvis than in cranial presentations. When the head is retained in the uterus after it has become detached from the body, it should be held by an assistant through the abdominal walls, and steadied by a crotchet introduced into the foramen magnum, or fixed into an orbit, or in the lower jaw. The cephalotribe may then be applied to complete the extraction.

Cranioclast.—It is necessary to distinguish between two instruments, each of which bears the name of cranioclast. The original model was the device of Sir J. Y. Simpson, and was intended by him to replace the cephalotribe. It is substantially a powerful pair of craniotomy-forceps. The larger blade, which is intended to be placed upon the outer surface of the head, is fenestrated and grooved. The smaller one, for introduction into the perforated skull, is solid, and supplied with ridges which fit into the grooves upon the opposite blade. The two blades articulate by means of a button-lock. By a twisting movement, the cranioclast, when applied, can be employed to wrench off the bones of the calvarium, different portions of the skull being seized successively with the view of accomplishing that result. As the fractured bones are covered by the scalp, they are prevented

from inflicting injury during the subsequent course of delivery. But the cranioclast is not only of use in breaking up the cranial vault, it is likewise the most effective of all the instruments employed for extraction of the perforated head.

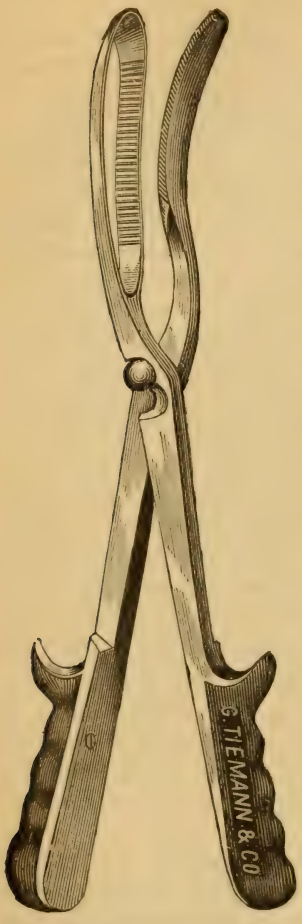


Fig. 189.—Simpson's cranioclast.

The principal defect of the Simpson cranioclast is that it attempts to combine in the same instrument the functions of crusher and tractor. Now, as in the cephalotribe, the devices which make it the most effective instrument in the one direction weaken its utility in the other. Braun's modified cranioclast is intended to serve purely as a tractor. All idea of its undertaking to break up the skull is discarded. The work of compression and disarticulation is left to the counter-pressure of the pelvic walls, and to the employment of craniotomy-forceps and the cephalotribe. The term *cranioclast* is therefore a misnomer. Mundé's proposed substitute of "craniotractor" is descriptive of its real action. Yet the modifications of Braun were as simple as they have proved appropriate. A pelvic curve has been given to the blades; the handles have been lengthened so that the lock, even when the instrument is introduced high up, is outside the vulva; and, finally, an apparatus for compression has been added. The advantages of Braun's cranioclast over its rival, the cephalotribe, are as follows: it is of comparatively small size; again, one branch lies inside the head, in a space not otherwise occupied; the outer branch imbeds itself in the soft coverings of the head, and thus is protected from doing harm. After a few tractions the cranioclast occupies the middle of the pelvis, where it can be so guarded by the hand that it need not even come into contact with the vaginal walls; as the head is drawn into the pelvis, the pressure is not concentrated at one or two points, but is diffused over the entire pelvic rim; the head is therefore able to mold itself to the shape of the pelvis. Subsequent to the use of Braun's cranioclast, extensive lacerations and injuries to the maternal organs are rarely found. The cranioclast takes firm hold of the head. It never slips during extraction. It is not apt to tear

away when the cranium and scalp are seized together. The most secure grip is obtained when the inner blade is passed to the base of the skull, while the outer one is applied to the face or over an ear.

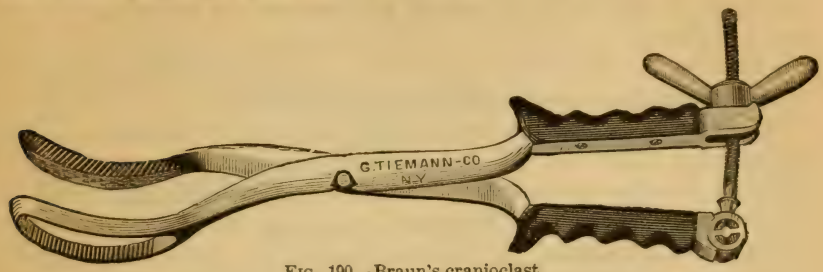


Fig. 190.—Braun's cranioclast.

Should the portion grasped tear away, the readjustment of the instrument upon another part of the skull is easy. Thus, the inner blade can be turned, of course, in any direction without difficulty, while the

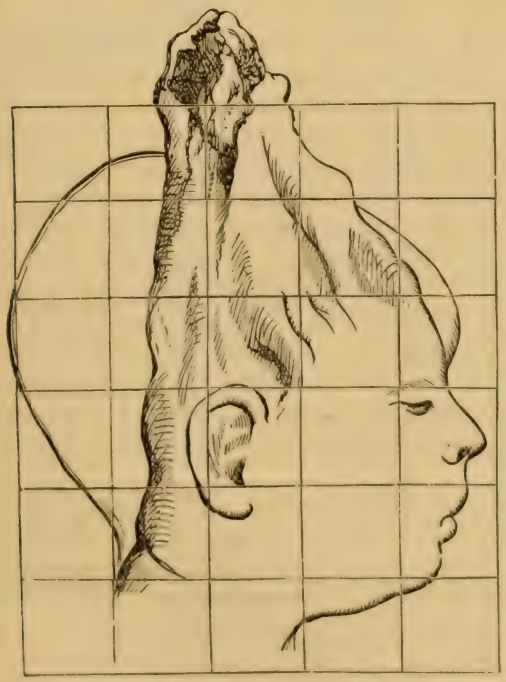


Fig. 191.—Head of child after delivery with the cranioclast. (Simpson.)

outer blade is easily disengaged from the scalp-tissues and changed in its position by direct pressure from the fingers and slight leverage movements of the handle.

The cranioclast may often advantageously be used as a tractor in

cases where the head has been previously crushed and flattened by the cephalotribe; but, where extraction with the latter is rendered difficult by slipping, or by the inability of the operator to make the altered diameters of the head correspond to those of the contracted pelvic space, the immense superiority of the cranioclast consists in the capacity to seize the head antero-posteriorly, and thus to bring its lengthened diameter into the transverse space of the pelvis.

The cranioclast enables us to extend the limits of safe delivery far beyond what would be admissible with the cephalotribe, as with its aid it is possible, after the partial or complete removal of the flat bones of the skull, to tilt the chin downward, and draw the base by the edge through the conjugate. In this way craniotomy may be resorted to in pelves measuring less than two and three fourths inches antero-posteriorly. Indeed, Barnes claims that one inch and three fourths in the conjugate and three inches in the transverse diameter furnish sufficient space for a successful operation.*

The proceeding to be pursued in these difficult cases is as follows: After perforation introduce a forceps-blade under the scalp, and detach the latter as far as possible from the cranial bones; break up and wash out the entire brain-mass; seize the parietal bones beneath the scalp with a good pair of craniotomy-forceps,† and break them away piecemeal by a twisting movement of the wrist. The withdrawal of the fractured bones is always a matter of delicacy. Unless the soft parts are carefully guarded by the hand, the maternal tissues are apt to be cut and lacerated by the sharp edges and splintered corners of the bones. Skene ‡ has found it a great aid, in some cases, to use a large-sized Sims speculum to bring the head into view, and to go through the various steps of craniotomy with the guidance of the eye. The suggestion is an excellent one; but when the head is high up, as is the rule in difficult cases, I have not always found it practicable to expose in this way the presenting part. Horwitz # recommends, in difficult cases of the unexpanded cervix, to perforate through a large Fergusson speculum.

After the removal of the parietal bones, the fenestrated blade should be placed under the chin, or in the mouth, while the smaller one is introduced inside the perforation, and applied so that the frontal bones are included in the grasp of the instrument. The blades should then

* Barnes, Obstetric Operations, p. 402. For discussion of this point, see Treatment of Contracted Pelves.

† Meigs's craniotomy-forceps has been largely used in America, and may be confidently recommended. There are two forms, one straight and the other curved. Dr. Taylor's modification consisted chiefly in increasing the length of the instrument, so as to render it more available in operations at the superior strait.

‡ Skene, Trans. of the Am. Gynæc. Soc., vol. ii.

Horwitz, Über ein Perforations Verfahren, Ztschr. f. Geburtsh. u. Gynaek., Bd. iv, p. 1.

be screwed tightly together by means of the apparatus for compression, and the head turned so that its bizygomatic diameter is brought into the transverse diameter of the pelvis. As the distance between the orbital plates and the chin, including the instrument, does not exceed

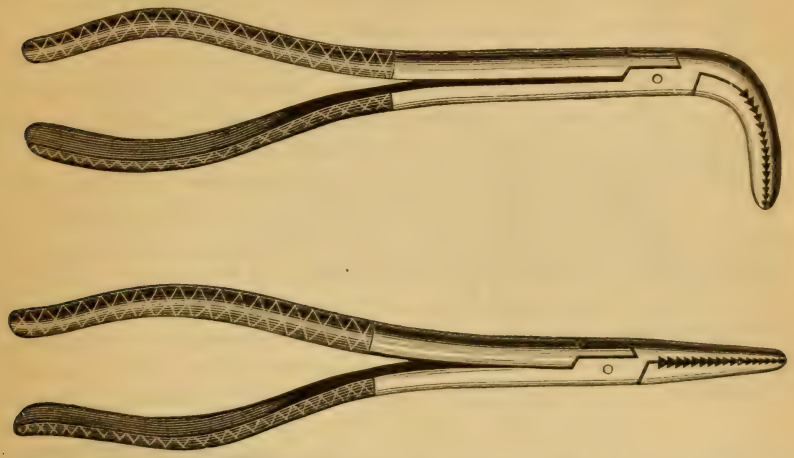


Fig. 192.—Meigs's craniotomy-forceps (modified by Professor I. E. Taylor).

two inches, and the width of the base is only about three inches, it is evident that, in skillful and experienced hands, this method is capable of almost indefinite extension.

After delivery of the head, the extraction of the body may still cause difficulty. If, then, through an opening made with a perforator between the clavicle and shoulder-blade the smaller blade be introduced, and the outer blade be applied on the back, so that the two include the spine, the cranioclast will seize the trunk firmly, and is capable of exerting great force as a tractor.

Crotchet and Blunt Hook.—As tractors, neither of these instruments is much in vogue at the present day. It is well, however, to become familiar with their uses, as we are not always placed where we can have a complete armamentarium at our disposal.

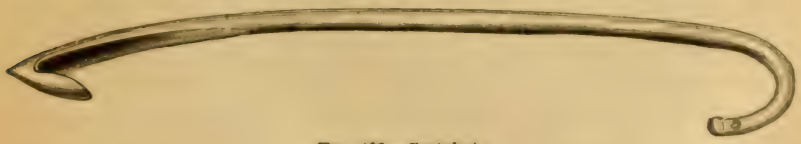


Fig. 193.—Crotchet.

The crotchet is a steel hook, with a sharp-pointed extremity. The shaft is either straight or curved to adapt it better to the convexity of the head. In craniotomy the instrument is often useful in breaking up the brain. It may be inserted into an orbit when it is desired to

bring the base of the skull end on into the pelvis. In default of either cranioclast or cephalotribe, it may be employed to extract the perforated head. To this end it should be passed through the opening and its point inserted into one of the bones of the cranial vault. Two fingers of the left hand are then passed to the outer surface of the skull, to serve as a guard and to make pressure against the point fixed upon the inner surface. If much resistance is met with, the part is apt to tear away, and a new hold has to be taken. When portions of bone are broken away they should be removed with the fingers, to prevent their doing harm. The process is often tedious, and in unskillful hands is not devoid of danger. When the bones of the vault yield under traction, a more effective grip may sometimes be obtained by fixing the crotchet at the foramen magnum or the sella turcica. Or, in place of introducing the instrument into the skull, it is sometimes inserted outside, behind the ear, into the mastoid process, or into the occiput, near the foramen magnum. The blunt hook, though not indispensable, is capable of rendering valuable service in delivering the head after the performance of craniotomy. Dr. I. E. Taylor gives the preference

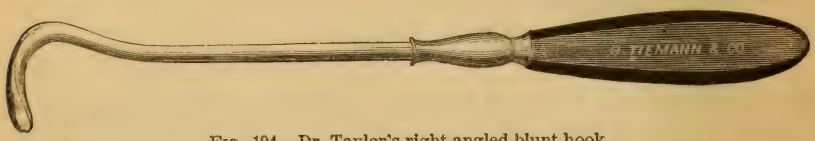


Fig. 194.—Dr. Taylor's right-angled blunt hook.

to a right-angled instrument. The blunt hook can not, of course, be attached to flat surfaces of bone. It may be used, however, to draw down the chin, or it may be thrust into an orbit. Where perforation has been made upon the after-coming head, the blunt hook may be introduced through the opening and traction made directly upon the base of the skull. In difficult cases, delivery of the trunk is sometimes favored by tractions made by a blunt hook inserted under the posterior shoulder.

Version.—Version, with extraction by the feet, with or without cephalotripsy, has been warmly commended by Bertin, Tarnier,* and Taylor,† while it has been condemned in harsh terms by others. Where it is practicable to perforate and turn early in labor, at a time when version is easy, the method has the advantage of bringing the longest diameter of the head into correspondence with the long diameter of the pelvis, and favoring the molding of the head to the shape of the canal it has to traverse. At the same time it avoids the dangers of contusing the soft parts incident to the use of the cephalotribe. Dr. Taylor recommends combining propulsion above the pubes with tractions made upon the extremities.

* Tarnier, Dict. de médecine et de chirurgie, art. Embryotomie, t. xii, p. 668.

† Taylor, What is the Best Treatment in Contracted Pelves? Trans. of the New York Acad. of Med., 1875.

Great ingenuity has been exerted to devise some good way to overcome the difficulty which grows out of the defectiveness of the preceding measures in acting directly upon the base of the skull. Cephalotomy,* or the removal of the head by segments, has been proposed as a substitute for perforation and cephalotripsy. Van Huevel's forceps-saw divides the head from crown to base into two halves. Tarnier's forceps-saw removes from the head a triangular segment, the apex of which is cut from the skull-base. Dr. Barnes † has suggested the application of Braxton Hicks's wire *écraseur* to successive portions of the head. Hubert's *transforateur* is designed to bore through the sphenoid, and thus to destroy the resistance of the base. The sphenotribes of Valette, Hüter, and the Lollines, are a combination of the cephalotribe and the *transforateur*. Notwithstanding the principle of cephalotomy is mechanically correct, the operation has never met with any general acceptance, partly owing to the high price and complicated structure of most of the instruments required for its performance, and perhaps in part to the fact that, in the higher degrees of pelvic deformity, where their advantages over the more familiar methods would be theoretically most complete, the bulky nature of the forceps-saws and the sphenotribes interfere with their employment. The favorable reports made by their inventors of the results they have personally obtained render, however, a reference to the subject necessary.

FIG. 195. — Segment removed by the Tarnier forceps-saw. (P. Thomas.)

EMBRYOTOMY.

In a literal sense, embryotomy includes all the graver operations designed to diminish the volume and resistance of the fœtus. Custom has, however, restricted the term to those operations only which are performed upon the trunk of the child. It is used, therefore, as a rule, in contradistinction to craniotomy, and not in its generic sense.

Indications for Embryotomy.—1. In extreme degrees of pelvic contraction, where the size of the body obstructs delivery.‡ 2. In fetal malformations, with abdominal enlargement due to pathological conditions of the more important viscera, and in cases of extraordinarily developed children. 3. In neglected transverse presentations, in which version is impossible, or at least can not be performed without endangering greatly the life of the mother.

* TARNIER, Dict. de Médecine et de Chirurgie, art. Embryotomie, p. 680.

† BARNES, Obstetric Operations, p. 411.

‡ It has been said that, in cases which do not demand the Cæsarean section, this indication is not likely to arise. In the extraction of the child's body, however, through a small justo-minor pelvis, which required for its completion upward of twenty-five minutes, *post-mortem* examination showed more extensive disturbances from arrested pelvic circulation, due to compression from the child's body, than from the lesions arising out of the performance of craniotomy.

Embryotomy includes two operative measures, viz., exenteration and decapitation.

Exenteration.—By exenteration we mean the opening of one of the large cavities of the trunk and the removal of the contained viscera. It is most commonly indicated in transverse presentations, where decapitation is not easy to perform, as in cases of extreme pelvic contraction with the head high up above the pelvis. The opening may be made by means of a pair of curved scissors or the ordinary perforator. The same precautions against injury of the maternal tissues have to be observed as in craniotomy. In shoulder presentations an assistant should press the fundus of the uterus downward. The operator at the same time thrusts the perforator, or the scissors, between the ribs, and then enlarges the opening by turning the instrument so as to make a second incision at right angles to the first. Next, splintered portions of bone should be carefully broken away with the fingers, until the opening becomes sufficiently extensive to permit the introduction of the half-hand. In tearing away the viscera, the fingers may, if necessary, be aided by the volsella-forceps. The abdominal cavity may be reached directly through the thorax by perforation of the diaphragm, or a fresh opening may be made through the abdominal walls.

After evisceration, the reduced bulk of the child renders it possible to proceed directly to seize the feet and perform version. This method is, however, generally difficult, and endangers the distended cervix and lower uterine segment. If, therefore, the shoulder is high up, the breech, which is easily reached, should be drawn down with the fingers or the blunt hook, in imitation of the mode of delivery in spontaneous version. When, however, an arm presents, and the shoulder is crowded into the pelvis, the child may be drawn through doubled upon itself, as in spontaneous evolution.

Decapitation.—Whenever, in neglected transverse presentations, the neck can be easily reached, decapitation furnishes the simplest and mildest plan for overcoming the difficulties which prevent delivery.

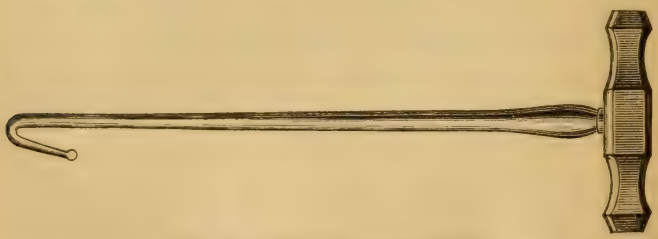


FIG. 196.—Braun's decapitating hook.

Decapitation may be effected in a number of different ways:

1. Draw upon the prolapsed arm to bring the neck well down and within reach. Pass the finger or a blunt hook around the neck, and

then, carefully guarding the points, divide with a strong pair of scissors by a series of short movements the soft structures and the vertebral column.

2. In many cases the division of the neck can be advantageously accomplished by Braun's decollator. This instrument is a modification of the blunt hook. The terminal portion is, however, bent at nearly an acute angle. It is likewise flattened from side to side, and ends in a button-shaped extremity. The handle is fixed at a right angle, and is capable of imparting to the instrument powerful leverage movements. In employing the decollator, the index and middle fingers of the left hand should encircle the child's neck from behind, while the thumb is placed upon the anterior surface. The neck should then be firmly grasped and drawn down into the pelvis as far as possible. The decollator should be passed up flat under the symphysis pubis along the thumb of the operator, until the button-end has advanced far enough to be turned to the rear over the neck. Finally, the instrument should be seized by the handle with the right hand, and rotated to and fro, while tractions are simultaneously made in a downward direction. It is surprising how quickly, as a rule, the spinal column may be divided by this manœuvre. After the separation of the vertebræ, care must be taken not to draw down with too much force, lest the integuments and soft structures yield suddenly, and violence be done by the rapid withdrawal of the instrument. This accident may be avoided by using moderate tractions and dividing the last remnant of the tissues with a pair of scissors. The decapitating

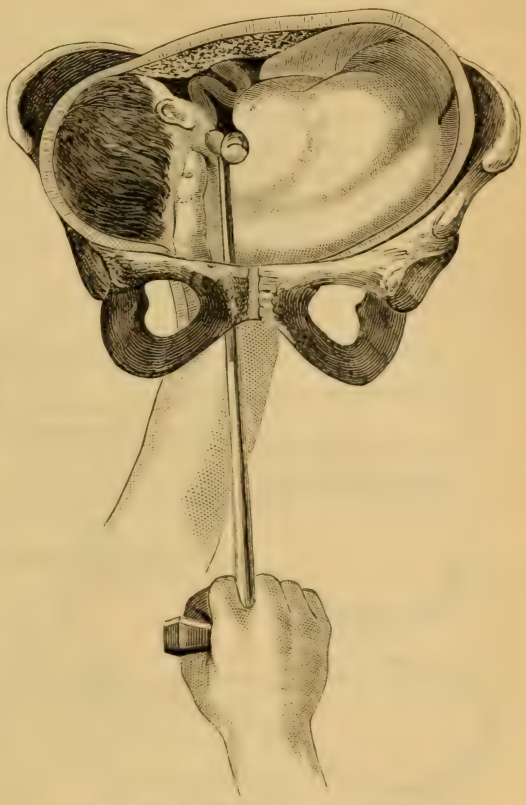


Fig. 197.—Braun's method of decapitation.

hook of Ramsbotham, which is curved, and has a cutting edge upon the concave part, is more difficult to apply, and is a less safe instrument in unskillful hands.

3. Pajot originated an ingenious method of decapitation, which, in default of special instruments, is capable of rendering valuable service. It consists in passing a strong cord around the child's neck, and, by a sawing movement, cutting through the parts. The vagina should be protected by a speculum from the friction produced by the to-and-fro movement of the string. The chief difficulty of the operation lies in getting the string around the neck. Pajot caused a groove to be made upon the concave surface of the blunt hook which forms a constant attachment to one of the handles of the ordinary French forceps. Through this groove he passes a string, to the end of which he fastens a round lead bullet; when the blunt hook is adjusted about the child's neck, the weight of the bullet draws the cord downward so that it can be reached by the hand of the operator. Dr. Kidd recommends attaching a string to an elastic catheter armed with a strong stylet; then,

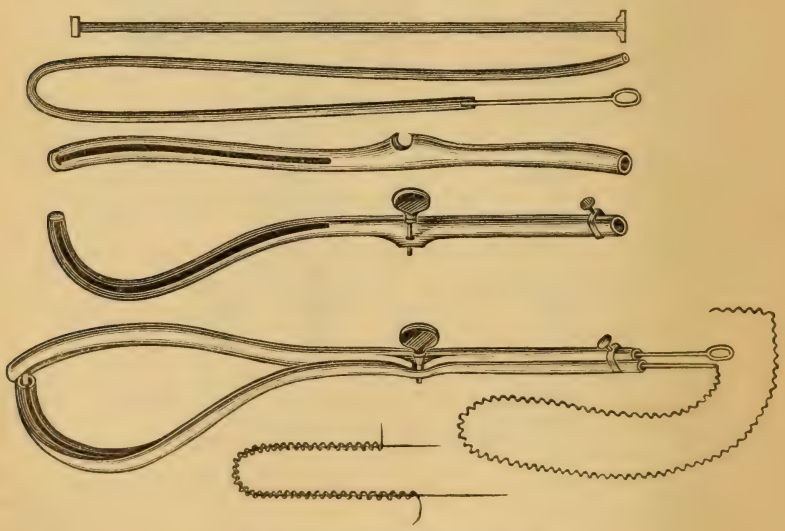


Fig. 198.—Embryotome of P. Thomas.

after imparting to the instrument the proper curve, it should be passed around the child's neck, and, as it is withdrawn, the string should be used to drag a strong cord or the chain *écraseur* into place.

Still more ingenious is the embryotome of Pierre Thomas, consisting of two blades modeled after a somewhat expensive instrument devised by M. Tarnier. The curved blade should be passed posteriorly opposite the sacrum. The straight blade should be introduced in front directly beneath the pubic bones. When adjusted, the extremities of

the blades are in apposition. Both blades contain a grooved canal. A piece of whalebone armed with an ivory knob is then introduced into the canal of the straight blade, while a long, flexible piece of whalebone provided with an ivory ring is passed into the canal of the posterior curved blade. The descent of the posterior whalebone fur-

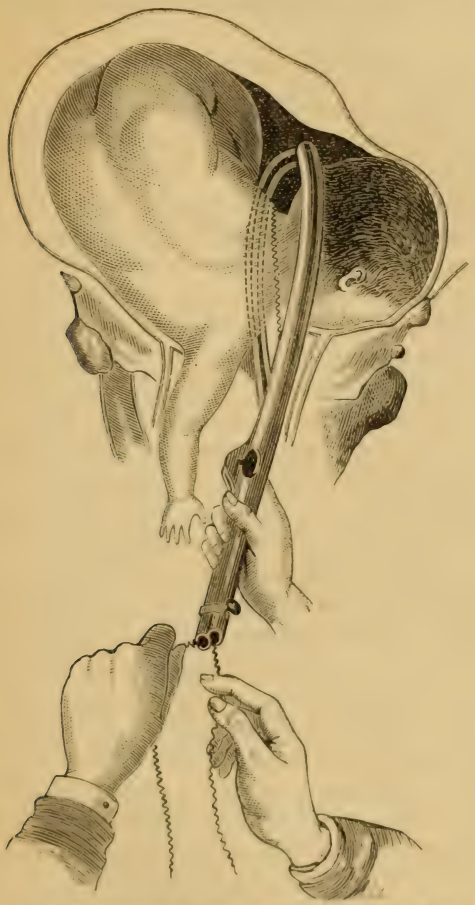


FIG. 199.—Embryotome adjusted around the neck of the child.

nishes the evidence that the canals of the two blades are in apposition, and that the longer piece has entered the posterior canal. When the circuit is completed, a loop of cord is passed through an eyelet in the end of the whalebone, and serves as an attachment to a chain-saw, which, as it is drawn upward, leaves the groove and encircles the child's neck. In decapitating the child by a to-and-fro movement, the soft parts are protected by the blades of the embryotome.

CHAPTER XXIII.

CÆSAREAN SECTION.—OPERATIONS OF THOMAS AND PORRO.

Cæsarean section. — History. — Indications.—Operation.—After-treatment.—Prognosis.—Operation of Porro.—Operation of Thomas.

The Cæsarean Section.

The term *Cæsarean section* is applied to cases in which the fœtus is removed from the mother by an incision made through the abdominal and uterine walls.

Although the operation pretends to great antiquity, the earlier histories are probably of mythical origin. The supposed references in the Talmud are, according to Rodenstein, mistranslations of the text. The same authority suggests that even the *lex regis*, attributed to Numa Pompilius, which makes it obligatory upon the physician to remove the child by abdominal section in case the mother dies during pregnancy, was really added to the Roman law in the middle ages, with the intention of giving force to the decretals of the Church, which sought, through the Cæsarean section upon the dead, to rescue the child for the rite of baptism before its life became extinct. During the sixteenth century there seems no reason to doubt the authenticity of certain cases of laparotomy, performed during the life of the mother, for the removal of the fœtus in extra-uterine pregnancies. In 1581 François Rousset* published the histories of fourteen successful Cæsarean sections, six of which were said to have been performed upon the same individual. These cases were repeated from hearsay, and from accounts taken from letters written by friends. Their genuineness was challenged at the time of publication by the opponents of the operation, and they are now generally regarded as resting upon questionable authority. The first operations mentioned after the publication of Rousset's work are said to have proved fatal. The earliest well-authenticated record of Cæsarean section comes to us from Germany. It was performed in Wittenberg, by Trautmann, in 1610. The patient lived from the 21st of April to the 16th of May. Scarcely any doubt was entertained of her recovery, when she was suddenly seized with a fainting-fit and died, contrary to all expectation, in about half an hour.

Until a very recent date the Cæsarean section was justly regarded as one of the most hazardous operations in surgery. Michaelis† collected 258 authentic cases, of which 54 per cent ended in recovery. Kayser‡

* Rousset, Traité nouveau de l'hysterotomotokie, ou enfantement Césarienne.

† Michaelis, Abhandlungen aus dem Gebiete der Geburtshülfe, 1833.

‡ Kayser, De Eventu Sectionis Cæsariæ.

added 80 new cases to those reported by Michaelis, and reduced the recoveries to 38 per cent. Mayer* gathered 1,605 cases, with 54 per cent recoveries. Pihan-Dufeilhay† collected 88 cases, published between 1845–'49, of which 57 per cent ended in recovery. Dr. Harris (1888) gathered with great industry the histories of 153 cases performed by the older methods in the United States, 56 of which, or nearly 37 per cent, ended in recovery. Under this showing it will be seen that at best fully one half of all the Cæsarean operations ended fatally. Spaeth, writing before the conservative operation of Sänger had changed the results of practice, said that there had not been a single case in the lying-in hospital in Vienna during this century in which the mother had survived. Baudon, writing in 1873, said, "In Paris there has not been one successful case in eighty years, though in the present century the operation has been performed on perhaps as many as fifty women."

The responsibility for these results was due, in the first place, to septic infection, the evils of which were especially experienced in hospital practice, and to the postponement of the operation until death impended. What was possible after eliminating these elements of danger even with barbaric methods of surgery, was shown in a report by Harris,‡ in which he gave the history of nine women whose wombs had been ripped up in advanced pregnancy by the horns of infuriated cattle, with the survival of four women and four children. Again, in six cases of self-inflicted Cæsarean section, five of the women recovered.

Of hardly less importance in blocking progress was the persistent superstition that the alternating contractions and relaxations of the uterus forbade the employment of the uterine suture. Consequently, the uterine incision was left to gape, and closure in favorable cases was usually effected by an adhesive inflammation which united the uterine to the abdominal walls. According to Sänger, only one instance is known where complete union took place throughout the length and depth of the wound. Sometimes cicatricial tissue extended the length but not through the thickness of the incision, and was of a callous consistency; in others the line of union was at points of extreme tenuity, disposing to hernial protrusions, and in subsequent pregnancies to rupture; while in others, again, union took place at intervals only, with the formation of fistulous openings, communicating with the abdominal walls, or with circumscribed cavities in the abdominal inclosure. Yet so strong are old prejudices, that even recently Porro's proposition to avoid the risks of the gaping of the uterine wound by

* Mayer, notice by Bromeisl, Wien. med. Woch., 1868, No. 67

† Pihan-Dufeilhay, Arch. Gén. de Méd., 1861, t. ii.

‡ Harris, Cattle-horn Lacerations of the Abdomen and Uterus in Pregnant Women, Am. Jour. Obst., July, 1887.

the removal of the entire uterus, was accepted as a surgical necessity. Indeed, it has been in this country chiefly, where tradition exerts a feeble influence, that prior to the appearance of Sänger's exhaustive monograph the suture enjoyed anything like a fair trial, and Sänger strongly re-enforced his argument in favor of its employment by the successes obtained through its agency by Polin, Brickell, Jenks, and Lundgren.

The improved Cæsarean section of the present day is based upon an early resort to the operation before the patient's strength is exhausted by lengthy labor and the futile resort to measures to extract the child by the natural passages; upon the complete closure of the uterine wound, and upon the employment of aseptic precautions, such as are commonly used in abdominal surgery. Sänger is justly regarded as its founder, for though others, and notably Harris, in this country, had insisted upon the importance of the same factors, the great body of the profession was still engaged in the task of showing that the Cæsarean section had profited nothing by the recent advances in surgical science when Sänger's work * was published. The latter at once awakened the dormant interest of the profession on the subject. Its challenge to test the question of the practicability of the Cæsarean operation, as modified by modern principles, met with a ready response, and the triumphant reinstatement of the measure in the domain of legitimate surgery followed. Since then the mutilating operation of Porro has been restricted within narrow limits, and the croakings of the anti-Cæsarean school are no longer heard.

Indications for the Cæsarean Section. — As even the improved Cæsarean section is a hazardous operation, its performance is chiefly justifiable in cases in which craniotomy and the delivery of the child by the natural passages involve the life of the mother in still greater peril. It is indicated, therefore, in extreme degrees of pelvic contraction, in the case of solid tumors which encroach upon the pelvic space, and in advanced carcinomatous degeneration of the cervix.

The Cæsarean section is permissible if the mother is moribund and the child is known to be alive, where rapid delivery by the natural passages is impossible It may be undertaken at the mother's request if otherwise delivery can not be accomplished without the sacrifice of the child. If in any case the decision is left to the physician, he should regard the welfare of the mother as of paramount importance. It has been said that if a woman, knowing herself to be incapable of bearing living children, exposes herself to the repetition of pregnancy, it becomes the duty of the physician to perform the Cæsarean section in the interest of the child. The duty of the physician is, however,

* SÄNGER, The Cæsarean in Cases of Uterine Fibromata: Criticisms, Studies, and Propositions for the Improvement of the Cæsarean Section.

to his patient. He is not to constitute himself either judge or executioner.

Operation. — The success of Cæsarean section depends in large measure upon the control which the obstetric surgeon possesses over the conditions under which the operation is performed. When it is practicable, the patient should be prepared for the operation by full baths, by disinfecting vaginal douches, by laxatives, by diet, and by tonics.

The most suitable time to operate is after dilatation has begun, but previous to the rupture of the membranes: after dilatation, because it is desirable to provide a free outlet for the uterine discharges subsequent to the operation, and because the retraction of the uterus after delivery, which furnishes the most efficient means of controlling hæmorrhage from the uterine wound, is best secured if the operation is performed at a time when the contractions are strong and frequent; previous to rupture, because there is then greater probability of finding the child alive and the maternal tissues uninjured. Unless, too, the head or breech protrudes spontaneously through the incision made in the uterine wall, the delivery is much more readily performed while the membranes are intact than after the uterus has retracted firmly down upon the child's body.

The necessary preparations should meantime be made, and selected assistants should have explained to them their respective duties. There should be one assistant to take charge of the anæsthesia, one to hold the uterus after it has been turned out of the abdominal cavity, one for the instruments, one to take charge of the newborn child, and, if still, to aid in its resuscitation, and a trained nurse to wash and keep account of the sponges.

Few instruments are required. The entire armamentarium should consist of one or two scalpels, a pair of blunt-pointed scissors, a half-dozen compression forceps, a needle-holder, curved needles, an irrigator, a powder-blower, aseptic towels, and vessels containing an abundance of warm carbolized water. The sponges should be aseptically cleaned * and carefully counted. A piece of rubber tubing will be needed to place around the lower uterine segment to control the hæmorrhage when the uterus is incised. For ligatures, silver wire, silk, and catgut have each their advocates. At present silk is favored by Sänger, Kelley, and others, as the preferable material—a choice in which I personally concur. At the time of operation instruments, sponges,

* To render sponges aseptic they should first be boiled in a weak solution of soda, and washed out in boiled water. They should then be soaked for two hours in a solution of permanganate of potash (1 : 4,000), and, after repeated washings in a four-per-cent solution of hyposulphite of soda, to which three to four per cent of muriatic acid has been added, should be preserved in a five-per-cent solution of carbolic acid. Zweifel, Arch. f. Gyn., vol. xxxi, p. 204.

wire, and silk should be placed in a two-per-cent solution of carbolic acid.

The operator and his immediate assistants should thoroughly wash their hands and forearms with soap and water. The nails should be cleaned with a nail-brush and nail-cleaner, and, after removing saponaceous materials with alcohol, the hands and arms should be bathed for several minutes in 1 : 1,000 solution of corrosive sublimate. During the operation clean white aprons should be worn.

Preliminary to the operation the patient's bowels and bladder should be emptied, and the vagina should be douched with a five-per-cent solution of carbolic acid. During the induction of anæsthesia pains should be taken to make sure that the auscultatory signs of fœtal life are present. After the patient has been placed upon the table the pubes should be shaved, and the abdomen should be cleansed in the usual manner with soap-suds, corrosive-sublimate solution, and ether.

The abdominal incision should be made to extend from a point above the pubes to one, three, or four inches above the navel. At this stage it is convenient to pass a half-dozen long wire sutures through the upper portion of the incision. For the moment the ends should be left free. The child can be removed from the uterus *in situ*, in which case an assistant should take pains to keep by external pressure the abdominal walls in close contact with the surface of the uterus; but it is a great convenience first to turn the uterus out of the abdominal cavity. This is accomplished without much difficulty, by first tilting the uterus so as to cause its left border to present at the incision, and then pressing the abdominal walls backward over the uterus. As it emerges the assistant should envelop it in a warm carbolized towel, and hold it at nearly right angles to the abdomen. The operator now tightens the sutures in the abdominal incision to retain the intestines, and places a flat sponge beneath the abdominal walls behind the uterus to prevent the entrance of fluids into the peritoneal cavity. The rubber tubing should be placed loosely around the lower uterine segment beneath the presenting part, or, where there are plenty of assistants, manual compression applied to the cervix may be employed to control hæmorrhage. I prefer, instead of beginning at the fundus, by a series of rapid strokes first to make a small incision down to the membranes in the median line just above the lower segment, and then to extend the incision rapidly upward with a pair of blunt-pointed scissors. If the placenta is encountered, it should be detached with the fingers and pushed to one side. The uterine incision should be between four and five inches in length. If the membranes are intact, they should be ruptured, and the child should be rapidly extracted. The rubber ligature should be tightened, if necessary, to control bleeding. As the uterus retracts, the assistant sees that the abdominal incision is kept in close

contact with the uterine surface. With a little care no blood or fluid need obtain entrance into the abdomen during the entire operation.

In many cases the membranes peel off intact with slight traction, and come away with the placenta. Adherent portions of decidua should be carefully detached with the fingers. I have found it easy to wash out the uterine cavity with a disinfectant fluid, by placing the irrigator nozzle in the wound and pressing the cut surfaces together while loosening for the moment the elastic ligature. The pressure of the hands prevents hæmorrhage, and the stream passes out unimpeded through the vagina. When this has been done the uterine cavity should be sponged nearly dry and the inner surface powdered over with iodoform by means of an insufflator.

The uterine incision should be closed by two sets of sutures, a stronger one of wire, silk, or catgut for the muscular structures, and a fine one of silk or catgut to approximate the peritoneal borders. The muscular sutures should be introduced one half inch from the borders of the incision, and passed obliquely downward to, but not including, the decidua. Of these, eight to twelve are usually necessary. For the peritonæum I have used an interrupted suture of fine silk, and have employed with great satisfaction the Lembert stitch to secure close union. Leopold advocates catgut for both deep and superficial sutures, on the ground that they produce less subsequent irritation; but care must be taken to secure catgut of good quality, and to tie the deep sutures with three knots.

After the suturing is completed a hypodermic injection of the fluid extract of ergot should be made into the skin of the outer surface of the thigh. The elastic ligature should then be loosened, and manual compression maintained until firm contractions have been secured. After replacing the uterus, the abdominal wound should be closed without haste, and with punctilious care. A full antiseptic dressing should be applied. The patient, finally, should be placed in bed with hot bottles around her, and, in case of failing heart-action, the usual restoratives should be applied.

As vomiting after the Cæsarean section is rare, the administration of liquid food by the stomach is possible almost from the first. Tympanites is sometimes distressing, but can often be relieved by injections of soap-suds in chamomile infusion, while in severer cases a calomel laxative may be administered (gr. ijss every five hours until action is produced). The abdominal stitches should be removed from the twelfth to the fourteenth day. In favorable cases the patient may sit up by the middle of the third week.

Trained nursing, frequent visits, and promptness in meeting emergencies count for much in securing favorable results.

In conclusion, it may be proper to state that if the patient's condition at the outset is fairly good, and the operation is performed with

every attention to detail, such as a well-equipped hospital renders possible, and the after-management is intelligently conducted, the prognosis is hardly doubtful. Recovery will almost certainly follow, and a new triumph will add to the fame of Sänger.

But if the patient has been operated upon in her own home, after a lingering labor, without needed assistance, perhaps by the light of a kerosene lamp and with preparations of a make-shift character, and after the work is ended she is left to the care of ignorant, prejudiced persons, it may be proper to call the operation by the name of Sänger, but recovery, if it occurs, must be regarded as partaking of the nature of a miracle.

Porro's Operation, or Ovaro-Hystorectomy. — The characteristic feature of the Porro operation consists in the removal, after the performance of the Cæsarean section, of both uterus and ovaries. As the result of experiments upon animals, its theoretical practicability was demonstrated as early as 1769 by Cavallini, and later, in 1823, by Blundell. G. Ph. Michaelis, in 1809, after referring to the danger from reaction following injury to any of the abdominal viscera, goes on to say: "That the danger specially depends upon this reaction, we see not only from the often greater associated disorders in other organs, but from the experience that, when the uterus has been removed so that the reaction in other organs falls away, the danger appears to be much lessened. Several cases are known where the uterus has been excised by ignorant persons without the occurrence of violent disturbances [Zufälle]. . . . It is a question, therefore, whether the Cæsarean section would not be rendered less dangerous by connecting with it the extirpation of the uterus." The ablation of the uterus after Cæsarean section was not, however, actually executed upon the living human female until 1868. The first operation was performed by Dr. Horatio R. Storer, of Boston, in the case of a patient whose delivery was rendered impossible by the natural passages, owing to a large-sized fibro-cystic tumor blocking up the pelvic cavity. The hæmorrhage which followed the incision into the uterine cavity proving frightful, Dr. Storer ligatured the cervix, and, having applied the chain *écraseur*, slowly removed the mass. Both the child and placenta were in a state of decomposition. The patient lived sixty-eight hours. At the time of the occurrence the hardihood of the operator was the subject of a good deal of unfavorable comment.

In 1874 Professor Edward Porro, of Pavia, having succeeded in preserving the lives of animals from which he had removed the gravid uterus, decided that, as soon as a chance offered, he would add to the Cæsarean section as a completive measure the ablation of the uterus and its appendages. The sought-for opportunity presented itself on the 21st of May, 1876. The patient had a rachitic pelvis, with an antero-posterior diameter reduced to one inch and a half. The child

was extracted living, and the mother survived. After the publication of Porro's report, the two Brauns and Spaeth, of Vienna, where the Cæsarean section had been proverbially fatal (no case saved in this century), resolved to give the new operation a trial. Spaeth led off with a success in June, 1877.

In 1888 C. Braun von Fernwald had operated twelve times with eight recoveries. Breisky operated seven times. All his cases recovered. So, too, Leopold has had eight cases, with eight recoveries; Krassawsky, five cases, with one death; Frank, six cases, with one death; Fehling, five cases, with one death; Tait, seven cases, with one death; and in the Santa-Caterina Hospital, in Milan, ten women were saved in thirteen operations. But while in practiced hands, with favorable surroundings and skilled assistants, the results have been brilliant, all operators have not been so fortunate. Thus, Dr. R. P. Harris, who has with untiring zeal made all questions connected with the Cæsarean section his peculiar province, informs me that the number of operations performed to March, 1885, in which the uterus and its appendages were removed after the extraction of the child, had swollen to 164 (3 moribund at time of operation), of which 70 only ended in recovery, or a little over 42 per cent. In a late paper* he states that in the five years ending with the close of 1889 there were reported 158 operations with 47 deaths, or a mortality of 29 per cent.

Chason, however, has collected 45 cases, reported between 1887 and 1889, with but six deaths, and in Meyer's† statistics for 1890 32 cases are given, with five deaths; an indication that the ill-success of the earlier trials was due rather to faulty methods and to defective asepsis than to the impracticable nature of the operation. The inferior rank it now occupies as compared with the Cæsarean section is not due to its being more dangerous, but to the fact that it involves a serious multilation. The removal of the uterus and its appendages as a sequence to the Cæsarean section is, however, indicated:

In osteo-malacia, owing to the influence of ovaro-hysterectomy in arresting that malady; in uterine atony following the Sänger Cæsarean operation; in cases where septic infection of the endometrium has occurred during labor; in new formations of the uterus, the removal of which is coincidently desired; in obstruction to the free escape of the lochia due to cicatricial narrowing of the parturient canal, and in complete rupture of the uterus with the passage of the child into the abdominal cavity.

Operation.—The preparations and the details of the operation are the same as in Cæsarean section, with the exception of those which have reference to the ablation of the uterus and the prevention of

* Status of Cæsarean Surgery, Gyn. Trans., 1891, p. 120.

† Jahresbericht ueber die Fortschritte auf dem Gebiete der Geburtshülfe und Gynaek., IV Jahrgang, 1891.

hæmorrhage. Careful attention to the details of antiseptic surgery is essential to a successful issue. In Porro's first case the abdominal incision was nearly five inches in length. After opening the uterus and removing the fœtus, the placenta, and the membranes, Porro lifted the emptied organ from the abdomen, and placed the *serre-nœud* of Cintrat around the lower segment, just above the os internum. The tissues were then constricted until all hæmorrhage from the cut uterine surface was arrested. The uterus was then cut away with a bistoury, the stump was brought outside of the abdominal wound, and held in position by strapping the handle of the *serre-nœud* to the patient's right thigh. Müller modified Porro's original method by enlarging the first incision upward sufficiently to enable an assistant to lift the uterus outside of the abdominal walls, and by applying compression above the cervix (either the wire *écraseur* or the Esmarch bandage) before opening the womb and removing the child. This plan offers the obvious advantage of rendering the operation bloodless, and of making it easy to prevent the entrance of the amniotic fluid into the abdominal cavity. Breisky, Litzmann, Müller, Tarnier, and Elliott Richardson, of Philadelphia, found no difficulty in thus drawing the uterus outside the abdominal cavity; Spaeth, Wasseige, Tibone, Chiara, and Carl Braun, on the contrary, either encountered great difficulties in performing the manœuvre, or were obliged to abandon it altogether. According to Harris, there have been forty-two Porro-Müller operations, with the saving of twenty-one mothers and thirty children. The compressors which have so far been employed are the Cintrat *serre-nœud*, the chain *écraseur* with a Péan attachment, rendering it possible after detaching the chain from the handle to maintain the constriction, the various forms of wire *écraseur*, and the elastic ligature. Compression should be made slowly, and should not be carried to the extent of cutting through the peritonæum. Owing to the liability of wire to break, great care should be taken in its selection. In case of accident, a second instrument should be held in readiness.

Fehling, whose excellent record we have already noticed, gives the following directions: After careful disinfection of the abdominal surface, the incision should be made in the median line. As the abdominal coverings are for the most part thin, ligatures are rarely necessary. The peritonæum should be divided upon a grooved director. Then either a median incision is made through the uterine walls with the uterus *in situ* and with the precautions against hæmorrhage described in connection with the older operation, or, as recommended by Müller, the uterus, after enlarging the abdominal wound, should be tilted laterally, and withdrawn outside the abdomen previous to section. An elastic ligature, placed rapidly around the lower uterine segment, furnishes a safeguard against hæmorrhage. In the Porro

operation proper the elastic ligature is used after removal of the child; in the Müller modification, which Fehling prefers, the ligature is applied previous to uterine section. In the latter case the child should be extracted as speedily as possible, for the sudden interruption of the placental circulation is decidedly more dangerous to the child than when it takes place gradually. The diameter of the ligature should be about one third of an inch. After the removal of the child and the tying of the cord, the field of the operation should be cleansed and the after-birth should be removed. Fehling next recommends the application of a second ligature beneath the first. Then the uterus and ovaries are to be removed, the stump cauterized, and pins inserted above the ligatures to prevent the recession of the stump. To insure the speedy and complete union of the peritoneal surfaces the latter should be carefully stitched to the stump beneath the ligatures. For this purpose a round needle and carbolized silk should be employed. Single sutures passing through the peritoneal borders and the uterine tissues should be introduced below and to the sides of the stump, and two sutures through the peritoneal borders and uterine tissues upon the upper surface of the stump. Above the latter two or three more sutures should be employed to bring together the peritoneal border alone. The abdominal sutures should next be introduced, and, after a final cleansing of the abdominal cavity, the wound should be closed. For a dressing Fehling employs iodoform, and fills the funnel-shaped space around the remains of the uterus with chloride-of-zinc cotton. Above he places iodoform gauze and cotton fixed in place by means of a wide bandage. The dressing, except in cases of bleeding or fever, may be left undisturbed for six to eight days. The separation of the stump occurs from the twelfth to the fifteenth day.

Among recent proposed modifications Sutugin* recommends, as a means of shortening the healing process, that, after the separation of the elastic ligature, the stump should be first scraped and pared to secure a raw surface, and that then the borders should be closed by ligature. For a day or two he leaves in the lower angle of the wound to secure drainage a tent of iodoform gauze about the size of the little finger.

Frank opens the abdomen and the uterus and removes the fœtus, then inverts the uterus and applies an elastic ligature which includes ovaries and cervix outside of the vagina. The abdominal wound is next closed and the uterus is amputated below the ligature. In this latter act the tissues are first incised down to the peritonæum, to which a separate ligature of silk is applied. The recommendations for this plan are said to be the simplicity of the technique, the rapidity with which the operation can be completed, and the minimal risk of

* Sutugin, Die Bedeutung des Porrosichen Kaiserschnittes, etc., Centralbl. für Gynæk., 1889, No. 66.

infection. Frank has operated eight times in the manner described, with the loss of but one patient.*

The intraperitoneal treatment of the stump, doing away with the dangers arising from necrosis, is correct in principle, but up to the present has not yielded as good results as the extraperitoneal method. It is indicated, however, after the removal of myomata imbedded in the pelvic cavity, and in cases where the Porro operation is employed for uterine rupture, when, owing to the deep seat of the rent, it is impossible to form a pedicle of sufficient length to reach above the abdominal incision.

The technique necessarily varies with the conditions. In general terms it may be stated that the plan of operation consists in turning out the uterus and applying a double series of ligatures to each of the broad ligaments. Between the median and outer ligature row the tissues are then divided and an elastic ligature is placed about the cervix. After amputation of the uterus a wedge-shaped portion should be excised from the surface of the stump, the cervical canal after thorough disinfection should be cauterized with the thermo-cautery, deep catgut sutures should be introduced to close the internal orifice of the cervix, and deep and superficial sutures inserted to approximate the muscular and serous surfaces together. After the removal of the rubber ligature the sutures should be tightened, and new ones introduced if oozing should render the latter necessary. Bleeding from the uterine artery is best controlled, according to Fritsch, by passing the central sutures obliquely, and in such a way as to cross one another, thereby including the vessel between them. Fritsch and Löhlein exsect the wedge of tissue from above downward instead of in a transverse direction, so as to make the line of the approximated surfaces run parallel to the abdominal incision. Instead of dropping the stump they sew its peritoneal surface to the abdominal peritonæum, while sutures passed through the abdominal walls and the extremities of the line of union on the stump serve to hold the line between the cut surfaces of the abdominal wound and above the peritonæum. Subsequent oozing into the peritoneal cavity is thus guarded against, while the healing is promoted by suitably applied aseptic dressings. Fritsch, before closing the abdomen, likewise employs a stitch to fasten the severed border of the broad ligament on each side to the peritoneal surface of the stump.

In fibroids seated below the pelvic brim the cavity left after enucleation should be closed by a series of deep and superficial sutures, or where of large size a counter-opening should be made into the vagina and drainage secured below by means of iodoform gauze, while the peritoneal borders of the capsule are sewed carefully together. In like manner in uterine rupture when a rent extends into the broad ligament, the safest plan seems to be to close the stump, after the amputa-

* *Vide* Beaucamp, Arch. f. Gynaek., vol. xl, p. 117.

tion of the intact portion of the uterus and trimming of the torn border in accordance with the principles indicated, and then to treat the rent in the ligament by a counter-opening into the vagina, by drainage below, and by closure of the tear in the peritonæum.

Thomas's Operation, or Laparo-Elytrotomy.—In Professor Thomas's operation, the dangers of opening into the peritonæum and wounding the uterus are avoided by incising the walls of the abdomen in the line of Poupart's ligament, lifting the peritonæum, and dissecting down to the vagina, dividing the vagina transversely, and then, having reached the cervix, extracting the child through the passage thus artificially created.

The credit of defending the practicability of the extraperitoneal delivery of the child above the pelvic brim belongs chronologically to Ritgen. It was the natural outcome of the teachings of Abernethy and Cooper, to whom we owe the ligation of the external iliac artery without opening the peritonæum. The *modus operandi* was carefully thought out by Ritgen, and was put by him to the practical test October 1, 1821. The incision through the vagina, which was made with a sharp bistoury in a longitudinal direction, was, however, followed by such profuse hæmorrhage that the operation was discontinued, and the ordinary Cæsarean section performed in its place. The patient died at the end of fifty-eight hours.*

In 1823 Baudelocque the younger, unaware of the work of his predecessor, advised an incision down to the peritonæum along the external edge of the rectus muscle, extending from the umbilicus to two inches above the pubes, separating the peritonæum from the iliac fossa with the finger introduced into the lower end of the wound, incising the vagina to a length of four and a half inches, and then leaving the expulsion of the child to nature, or extracting it with the short forceps. In 1884 he published an essay reporting two cases in which he had tried his plan, modified, however, by substituting the flank incision of Ritgen for that along the rectus muscle. Like Ritgen, Baudelocque did not complete his first operation, owing to the extent of the vaginal hæmorrhage. In his second case he succeeded in delivering the child, which was, however, dead at the time of his undertaking the operation. Having accidentally pricked the external iliac artery, Baudelocque tied the common iliac, in order to arrest the hæmorrhage thence resulting. The labor was likewise complicated by convulsions. Death took place on the fourth day. The merit of first performing laparo-elytrotomy belongs, therefore, to Baudelocque.

In 1837 Sir Charles Bell, in his Institutes of Surgery, suggested practically the same plan of procedure as that subsequently advocated by Dr. Thomas.

* For the particulars of this and the succeeding cases, the writer is indebted to Dr. Henry J. Garrigues's model essay On Gastro-Elytrotomy, N. Y. Med. Jour., October and November, 1878.

In 1870 Dr. Thomas, who was at the time unaware of the labors of his predecessors, read a memorable paper before the Medical Association of Yonkers, giving an account of, first, laparo-elytrotomy performed tentatively upon the cadaver of a woman dying in the ninth month of pregnancy; and, second, upon a living woman at the end of the seventh month of pregnancy, who had been suffering from pneumonia for a week or ten days, and was at the time of his visit *in articulo mortis*. The operation was undertaken in the interest of the child, which was extracted alive, and survived about an hour. In 1874 the operation was repeated by Dr. Skene. The patient had been forty-eight hours in labor, and unsuccessful attempts at delivering her by craniotomy had been resorted to. She was suffering at the time of the operation from exhaustion and shock, which gradually became more marked, and she died seven hours after. In 1875 and in 1877 Dr. Skene had the glory of successfully performing the operation under circumstances of great difficulty, with the result in each case of saving the lives of both mother and child. In 1877 Dr. Thomas had the good fortune to obtain a like triumph. In England the operation has been performed by Drs. Himes and Edes, both times in the interest of the child, the condition of the mothers being well-nigh hopeless. Both children were saved. In 1880 Dr. Walter R. Gillette * extracted by laparo-elytrotomy a putrid child, which he was obliged to perforate and extract with the cephalotribe, the forceps and version having been previously tried without success. The mother recovered with scarcely an untoward symptom.

In 1883 Professor W. H. Taylor, of Cincinnati, operated with a fatal result. Forceps, craniotomy, the cranioclast, and version had been previously tried in vain. When laparo-elytrotomy was decided upon, the patient was much exhausted, with a very rapid, feeble pulse and elevated temperature. The patient died forty-four hours after the operation. In the same year Professor Jewett, of Brooklyn, operated upon a patient who had been a week in labor. The woman was exhausted by long labor, and previous attempts at replacing the arm, by the use of forceps and by attempts at version. The uterus was in a state of tonic contraction, and the soft parts were excessively œdematous. The child died before delivery. The mother died seventy hours later of acute septicæmia.

In the year 1885 Drs. Skene and Jewett operated each successfully, and since then an additional successful case has been reported by Dr. McKim. The statistical results, therefore, of laparo-elytrotomy are the saving of seven mothers in thirteen operations. But in no one of the fatal cases were the conditions such as to render success a possibility.

* Gillette, A Successful Case of Laparo-Elytrotomy, Am. Jour. of Obstet., January, 1880, p. 98.

The vaginal hæmorrhage noted in the cases of Ritgen and Baudelocque can apparently be avoided by tearing the vagina transversely, as recommended by Thomas, in place of incising it with a bistoury. In four of the cases vesico-vaginal fistulæ were produced, but all healed spontaneously. The following description of the operation is borrowed from the excellent essay of Dr. Garrigues, which has already been quoted. It has received the sanction of Drs. Thomas, Skene, and Gillette, with the exception that, in discussion, all have agreed that it is desirable to insert a perforated drainage-tube through the abdominal wound into the vagina, and to keep the parts cleansed with antiseptic injections.

Operation.—"The bowels having been emptied by an aperient and a copious enema, and the os having been fully dilated by Barnes's water-bags, if it is not so already, the patient is placed on her back, on a long, narrow table covered with a mattress or quilts, rubber or oil-cloth, and a sheet. The pelvis is well elevated on a hard cushion, the head and shoulders slightly raised by means of pillows, the legs stretched out. If, from some cause, it has been impossible to dilate the os fully by Barnes's dilators, it is now done by the fingers, or if that is impossible too, it is dilated later through the abdominal wound. The patient is anæsthetized. Since disinfection can not be carried out strictly, and since its administration would give some additional trouble, it is scarcely necessary to operate under disinfectant spray.

"The operator takes his place at the right side of the patient. Besides one who administers the anæsthetic, four assistants are needed—one on either side of the operator, and two in front of him. The first assistant, standing at the left of the patient's chest, lays his flat hands under the umbilicus and draws the uterus upward and toward the left, thereby putting the skin in the right iliac region on the stretch. Counter-extension may be made by the assistant placed at the right of the operator. A slightly curved incision is made through the skin from a point one inch and three quarters (4·5 centimetres) above and outside the spine of the pubes, parallel to and an inch above Poupart's ligament, to a point an inch above the anterior superior spine of the ilium. This incision may also be made in the opposite direction, from without inward. By a few touches with the edge of the knife the external oblique muscle is laid bare, and spouting branches of the superficial epigastric artery secured by holding-forceps. The abdominal muscles are cut to the same extent, layer by layer, the external oblique, the internal oblique, and the transversalis, the first of which is aponeurotic. The transversalis fascia is very carefully hooked up with a fine tenaculum, and the knife carried horizontally, so as to make a small opening in it, avoiding the peritonæum that lies beneath it, separated from it by loose areolar tissue, and sometimes fat. A director is introduced through the opening and pushed between the

fascia and the peritonæum toward the inner and the outer angle of the wound, and the fascia is cut. The best instrument for this purpose is Key's hernia director, the one which Spencer Wells uses when incising the peritonæum in ovariotomy. It is firm, a quarter of an inch (six millimetres) broad, slightly curved on the flat, well rounded at the end, and has on its concave side a groove that stops a quarter of an inch (six millimetres) from the point of the instrument. Next, the operator places the pulp of his fingers on the peritonæum, separating it from the transversalis and iliac fasciæ, until he reaches the vaginal wall. The second assistant, placed at the left of the operator, holds the peritonæum and intestines, applying a fine, warm napkin under his hands, in order to be sure not to let them slip. The first assistant draws the uterus vigorously upward and toward the left, in order to expose the deeper part of the vaginal wall on the right side. A female silver catheter is introduced into the bladder by the third assistant, placed at the left hip of the patient and held in the known direction of the boundary-line between the bladder and the vagina, below the ureter on the side on which the operation is being performed. A blunt wooden instrument, something like the obturator of a cylindrical speculum, only longer, is introduced into the vagina and applied above the linea ileo-pectinea, raising the vaginal wall as much as possible into the abdominal wound. An incision is made parallel to the ileo-pectineal line and the catheter felt in the bladder, as far below the uterus as possible, in order to avoid the ureter and Douglas's pouch, and incise where there are fewest vessels, cutting down on the obturator with Paquelin's thermo-cautery, the galvano-caustic knife, or simply cautery-irons (table-knives) only heated to *red* heat. The surrounding parts are protected by the application of wet compresses around the place to be cauterized. The incision made by the cautery is extended forward toward the symphysis and backward toward the promontory by placing the pulp of both index-fingers perpendicularly on the edges, and applying the force in different places in the direction of the os uteri and the ileo-pectineal line, so as to *tear* the vaginal wall as far forward as is deemed safe in regard to the bladder and the urethra, the locality of which organs is ascertained by feeling the catheter held by the assistant, and as far backward as the wound in the abdomen will allow. Now the catheter is withdrawn, the membranes ruptured if the liquor amnii has not escaped before, the uterus tilted as much as possible to the opposite side, and the os drawn with the forefinger into the iliac fossa.

"The operator draws the child through the double wound either by simple extraction, or after turning, or by applying the forceps, according to the presentation and other particular circumstances. The placenta is expelled by compressing the uterus, and withdrawn through the wound.

"If bleeding occurs, the operator tries to check it by applying ligatures through the abdominal wound, holding-forceps, styptics, or cauteries, using a large wooden tubular speculum; or a Sims speculum may, perhaps, give easier access to the bleeding vessel than anything else. If it be impossible to check the hæmorrhage, the vaginal wound must be firmly tamponed from below through the vulva and from the abdominal wound with cotten pledgets soaked in cold water and squeezed, and held *in situ* by broad straps of adhesive plaster round the abdomen, as after ovariotomy. Except in the last eventuality, the bladder is distended by injecting lukewarm milk in order to ascertain if this organ has been injured. If so, the fistula is immediately sewed with catgut, which need not be removed. The wound is cleaned by injecting a stream of lukewarm carbolized water (two per cent), or a solution of thymol (two per thousand), from the vagina and from the abdominal wound. Next, the edges of the abdominal wound are brought together by interrupted sutures, and the lower part of the abdomen covered with borated or salicylated cotton, and surrounded by broad straps of adhesive plaster fastened to the hips, as in ovariotomy. A pledget of cotton soaked in carbolized oil (1 to 10) is applied at the entrance of the vagina."

Professor William M. Polk has demonstrated that the operation can be performed as well upon the left side as upon the right.*

* Polk, N. Y. Med. Jour., May, 1882.

THE PATHOLOGY OF LABOR.

CHAPTER XXIV.

ANOMALIES OF THE EXPELLENT FORCES.

Precipitate labors.—Tardy labors.—Irregular pains in the first stage of labor.—Treatment of protracted first stage.—Irregular pains in the second stage.—Treatment of protracted second stage.—On the use of ergot in labor.—Irregular pains in the third stage; treatment.—Painful labors: from hysteria; from rheumatism; from intestinal irritation; from inflammatory changes.

In physiological labor the expellent forces are adequate to overcome the resistance encountered. Labor becomes pathological—1. When the pains are defective; 2. When the resistance offered by the soft parts or the bony pelvis exceeds the limits of safety to the mother or the child; 3. When natural delivery is rendered difficult or impossible, owing to malformations or malpresentations of the fœtus; 4. In consequence of dangerous complications, such as hæmorrhage, eclampsia, and prolapsed funis.

From a clinical point of view the anomalies of the labor-pains are divisible into pains in excess, weak pains, pains attended by an extreme of physical suffering, and pains complicated by strictures. Physiologically, however, these different forms are far from composing distinct conditions, isolated from one another. Thus, rigidity of the os is always intensely painful, and is usually dependent upon feeble action of the expellent forces. There is no standard of strength by which the weakness or excess of pains can be measured. The terms are always relative, and are used with reference to the obstacles to be overcome. In primiparæ strong pains are requisite to induce softening and dilatation of the cervix. In multiparæ pains may be intrinsically weak, and yet suffice to bring labor to a prosperous conclusion. Much confusion of mind is often occasioned by the double sense in which the term "labor-pains" is employed. Thus, it is frequently stated that the pains are good, when an examination reveals only a feeble measure of expellent force, the word "pains" representing nothing more than an acute degree of physical suffering. Clinically, pains are to be judged by the effects they produce. In practice it will be found convenient to study the various forms of irregular uterine action in connection

with the results of their influence upon the duration of labor. These results are—1. Precipitate labor; 2. Tardy labor.

Precipitate Labors.—It is customary to ascribe precipitate labors to an excess of the pains. The term excess is, however, only relative. There is no reason to believe that the uterus ever acts with such a degree of energy as *per se* to constitute a pathological condition. With a large, roomy pelvis, a soft, dilatable cervix, a distensible vagina and perinæum, labor may be terminated by a few strong pains. Such rapid deliveries are not to be regarded with apprehension. As a rule, they are followed by firm retraction of the uterus, and the continuance of good contractions acts as a safeguard against hæmorrhage. The puerperal state usually pursues a favorable course. Aside from the inconvenience which sometimes results when, perchance, women are suddenly overtaken by labor-pains in the streets or in public places, an easy, rapid labor is to be regarded as one of the varieties of normal labor. Except the adoption of precautions against such untoward accidents, they call for no special treatment.

When, however, the parturient act occurs in women who possess an undue reflex irritability, which impels them to an excessive use of the abdominal muscles, it is possible for serious mischief to ensue. Thus, if the patient happens to be seized when in the standing posture, the straining efforts may throw the child suddenly upon the floor; but even here the consequences are less detrimental than would be naturally anticipated. The force of the fall is usually broken by the cord. Lacerations of the latter take place at a distance from the navel, and are not followed by hæmorrhage. *Post-partum* hæmorrhage, prolapse, and inversion of the uterus are said to be possible occurrences, though of extreme infrequency. When all the expellent forces are called into play at an early period of labor, before the rigidity of the utero-vaginal canal has been overcome, the violent straining has been known to cause subcutaneous emphysema of the head and neck, to interfere with the utero-placental circulation, and even to produce fracture of the fetal skull. Excessive straining before the soft parts have been properly prepared for the passage of the child may likewise lead to lacerations of the cervix, vagina, and perinæum.

The proper treatment for this condition is to lower the reflex irritability by hypodermic injections of morphia; or, better still, by the production of complete anæsthesia, so as to suspend the action of the voluntary muscles.

Tardy Labors.—For the proper understanding of labors protracted beyond the period of safety by irregular uterine contractions, it is necessary to bear in mind the principal features of normal delivery. These are, contractions of the uterus followed by relaxation and distinct periods of repose; stretching and thining of the muscular fibers below the contraction ring, with retraction of the uterus above that

point; softening and dilatation of the cervix; the fixation of the uterus in the axis of the pelvis; and the addition of the abdominal muscles to the expellent forces.

The first requisite of every normal labor is that the pains shall be good—i. e., shall possess a markedly expulsive character. We have seen that for the uterus to perform work the contractions should not be continuous, but distinctly rhythmical. For effective work, moreover, the excursions of the uterus during a contraction should possess a certain degree of amplitude, and the interval between the contractions should be sufficient to allow the nervous system to recover from the shock of pain.

Irregular Pains in the First Stage of Labor.—In the first stage of labor pains are most frequently defective by reason of their short duration. As a rule, short, cramp-like pains occasion acute suffering. When they recur with little or no interval between them, they are very exhausting to the patient. As the cervix in such cases is tense and rigid, it is to this condition that the delay is usually attributed. If, however, the tissues of the cervix are healthy, the presentation is normal, and the pains preserve their expulsive character, rigidity of the cervix is never an obstacle to delivery. The activity of the organic changes which lead to softening and dilatation is closely related to the activity of the uterine contractions. The exception to this rule in primiparæ is only apparent. To be sure, in them the firm, closely knitted tissues of the cervix yield more gradually to the dilating forces than in multiparæ. Indeed, in multiparæ we sometimes find the organic changes in the cervix induced by contractions which have hardly excited the notice of the woman; but in primiparæ, while good pains, under the reservations mentioned, certainly induce softening of the cervix, weak pains effect no changes in its tissues.

The uterine contractions may be abnormal from the commencement of labor; more frequently the loss of their expulsive character is a secondary condition. In many primiparous women labor progresses in an auspicious manner for a time, inspiring hopes of a speedy termination. Then the cervix, which had previously been dilating favorably, becomes rigid, the sufferings of the patient during each contraction are enhanced, and further advance is arrested. This transformation is not to be accounted for by a spasm of the circular fibers of the os, but is the result of secondary changes in the action of the uterus itself. The right understanding of the phenomenon in question renders it necessary to recall the physiological fact that the uterus is endowed not only with contractility, but with retractile properties likewise. These are shown in a marked way by the manner in which the uterus closes upon its contents after the escape of the amniotic fluid; so, too, by the manner in which the uterus follows down the fœtus during the period of expulsion. Normally, the gradual closure

of the uterus upon the ovum leads with a dilated os to the permanent formation of the bag of waters. Thus it will be seen that in normal labor retractility is a wholly beneficent possession of the uterus. When, however, from any cause the cervix dilates slowly, and the pains are strong and close together, as the uterus retracts upon the stationary ovum, the excursions made by the labor-pains shorten, which thus tend to assume the clonic form. The continuance of the same process leads finally to the close investment of the ovum by the uterus, when the only indication of contractility which remains is the increased hardening of the uterus at short intervals. These changes in the character of the contractions are marked by corresponding changes in the cervix, the condition of the latter affording an index of that of the entire uterus in much the same way that a furred tongue bespeaks a catarrhal condition of the stomach.

These secondary changes in the pains are dependent upon a variety of conditions. The tardy dilatation of the cervix, which stands in a causal relation to them, may result from overdistention of the membranes with amniotic fluid, or from their firm adhesion to the walls of the uterus around the os internum—conditions which, in either case, interfere with the stretching of the lower segment, and thus lead to waste of uterine force by distributing it uniformly over the entire ovum. Again, where there is lack of parallelism between the axis of the uterus and that of the pelvic brim, the presenting part may, by bearing especially upon the anterior portion of the lower uterine segment and of the cervix, exercise so little pressure upon the os that its sphincter long maintains its integrity. Finally, irregular contractions may be consequent upon faulty presentations, and upon any form of pelvic obstruction.

A special and dangerous form of irregularity results when the membranes rupture prematurely, and the entire amount of amniotic fluid leaks away. This, to be sure, is a rare event, as the presenting part, as a rule, acts as a valve which closes the lower segment of the uterus, and prevents the amniotic fluid from escaping. When, however, owing to the small size, the uneven shape, or the hindered descent of the presenting part, the accident in question takes place, as a combined result of muscular retractility and the pressure of the intestines during the pains, the uterus gradually conforms to the surface of the fœtus. In this way the much-dreaded "dry labors" are produced. The consequences are far-reaching. The retraction of the muscular fibers about the child's neck in head presentations forms an impediment to natural delivery; the disturbance of the utero-placental circulation endangers the life of the child; the uterine walls applied to the convex surfaces of the child become anæmic, while the re-entrant portions, subjected to negative pressure, become hyperæmic and œdematous, extravasations take place into the tissues, the walls are rendered

friable, the contractions are associated with intense pain, and peritoneal irritability develops.*

The prolonged retraction of the uterus may be followed in the end by the entire cessation of pains, and paralysis may ensue. Uterine retractility is not precisely the same force as that which causes the expulsion of a fluid from an overdistended elastic sac, for retractility and contractility are in the uterus rarely disassociated from one another. When the uterus ceases to contract, it forfeits, as a rule, its retractile properties likewise.† It sometimes follows, therefore, that, following prolonged tonic contraction, after the evacuation of the uterus, the walls of the latter collapse like those of a pricked bladder.

The Treatment of a Protracted First Stage.—The treatment of a protracted first stage has for its object the mitigation of pain and the restoration of their expulsive quality to the uterine contractions. No plan of action should be decided upon without first carefully investigating the cause of delay. The suspensive influence of a full bladder or rectum is always to be borne in mind. In face, breech, and shoulder presentations, and in contracted pelves, the slow dilatation of the cervix is the rule, and, with such exceptions as will be noted in their appropriate connections, do not call for interference. A faulty position of the uterus should, if possible, be rectified by suitable abdominal support. Adhesions of the membranes to the lower uterine segment should be dissected up by the index-finger. In hydramnion, rupture of the membranes, so as to allow the partial escape of the amniotic fluid, is sometimes serviceable.

If the length of the labor is simply due to the insufficient uterine action, the conduct of the accoucheur will, in a measure, depend upon the frequency and severity of the pains and the endurance of the patient. If the pains occur at such intervals and with such mildness that the patient is able to eat, to sleep, and to attend to ordinary household duties, the dilatory progress of labor should cause no apprehension. In pathological conditions it is the element of pain which is most to be dreaded. Pain long continued is a powerful nerve-depressant When combined with starvation and deprivation of sleep, it greatly impairs a woman's capacity to resist the perils of the puer peral period. While, therefore, the indication for treatment is clear enough, it is not so easy in a given case to decide whether the remedy should be applied first to the relief of pain, or whether efforts should be directed at once to the acceleration of labor, so as most speedily to place the patient beyond the hazards of parturition. As a rule, however, it may be stated that anodynes are appropriate in cases where the

* Lahs, Die Theorie der Geburt, pp. 285 *et seq.*

† Breisky, Ueber die Behandlung der puerperalen Blutungen, Volkmann's Samml. klin. Vortr., No. 14, p. 92.

cervix is but slightly dilated, while accelerative measures naturally receive the preference in those where the first stage of labor is already far advanced.

The pain-stilling agents from which the selection should be made are the warm bath, chloroform, chloral by rectal injection, and morphine, either alone or combined with minute doses of atropine. In practice it will usually be found convenient to begin with chloroform, and then to sustain its action by the hypodermic injection of morphine, or the rectal administration of chloral, suspending the chloroform so soon as the tranquillizing effect of the latter is developed. Anodynes often accomplish wonders in one of two ways: when, owing to the prolongation of the labor and its attendant pain, the patient's nervous energies have become exhausted, the arrest of pain enables the woman to sleep, and, with the recuperation of power that comes upon awakening, good pains follow, which bring the labor to a happy termination. In other cases, after the employment of the anodyne the parts apparently relax, and an acceleration of labor follows. In these cases the oxytocic effect is probably due to the quieting action exerted upon the spinal nerves. It has been surmised that the nerves of the uterus derived from the cerebro-spinal system possess inhibitory properties—a theory which, if true, readily explains how severe pain suspends uterine action, and how the quieting of pain would restore to the motor nerves their full energy.

In a certain proportion of cases the effects of the anodyne or anæsthetic are of but short duration. In from ten to thirty minutes the acute suffering returns, and the short truce is unattended with benefit. There is an erroneous opinion that, so long as the membranes are unruptured, this condition may be allowed to go on indefinitely. It is, however, of the greatest importance that the length of the period of non-interference should be governed by the strength of the patient. There is nothing that requires more judgment in midwifery practice than to decide when the time has arrived at which delay is fraught with more danger than active interference. For my own part, I believe that many fair lives are needlessly squandered because of excessive timidity begotten of imperfect obstetric teachings.

If pain-stilling agents do no good, or if the first stage is already far advanced, the physician should seek, by restoring to the pains their expulsive character, to hasten delivery.

Of reputed service in cases of uterine insufficiency are the warm vaginal douche, the dilating bags of Barnes, the introduction of a bougie into the uterus, forceps, and the internal administration of quinine, ergot, viscum album, borax, cannabis Indica, cinnamon, or digitalis.

The bougie is applicable only to cases where the membranes are intact, and where the pains are weak without being cramp-like in char-

acter. It should in all cases be surgically clean, as otherwise it can become the carrier of infection to the uterine cavity.

The vaginal douche possesses a wider range of utility. It is safe and tolerably effective under favorable conditions. It promotes the organic changes in the cervix, stimulates the uterus to contract, and mechanically distends the vagina. Its action is, however, apt to be slow and somewhat uncertain. In a case of overdistention of the amnion, I once saw its employment followed immediately by complete tonic rigidity of the uterine muscular fibers.

Of all the resources at our disposal, however, the water-bags of Dr. Barnes stand easily at the head. Passed within the cervix, and distended so as to place the canal moderately upon the stretch, they not only serve to mechanically dilate the os, but are most efficient as reflex excitors of the labor-pains. If left *in situ* until expelled into the vagina by the bearing-down efforts they awaken, the cervix will be found to have lost its rigidity. If necessary, a larger dilating-bag should then be employed in the same way. An attempt to dilate the cervix rapidly and with violence is neither safe nor profitable. To obtain permanent results it is essential to effect the organic changes in the tissues which render them physiologically dilatable. In cases of tonic rigidity of the uterus, the production of normal pains will sometimes be assisted by rupturing the membranes and raising the head, so as to allow a small portion of the amniotic fluid to escape, previous to resorting to the Barnes water-bags.

When, after rupture of the membranes, a segment of the head presents at the os externum, the rubber bags are of less service. In such cases often we are able to accomplish speedy dilatation by simply asking the woman to hold her breath, and to re-enforce the uterine pains by the action of the auxiliary muscles. If this plan fails, forceps should be applied, and the head be made to serve as the dilating body. To avoid lacerating the cervix, the tractions should be intermittent, and should be suspended during the acme of the pains. The rule given for the preservation of the perinæum will be found most serviceable in attempts to maintain the integrity of the cervix, viz., that the extraction is most safely accomplished during the period of greatest relaxation, and not at the moment of extreme tension.

Of the various internal remedies to stimulate uterine action, ergot should, in the first stage of labor, be unqualifiedly prohibited. In spite of numerous favorable experiences from its use, its tendency to intensify tonic contraction of the involuntary muscular fibers makes it always a perilous drug. The enthusiastic praises of quinine by Drs. Fordyce Barker and Albert H. Smith, of Philadelphia, warrant further trials of its efficacy. Dr. Smith says: "I do not hesitate to give it in every case, because, even where there is no decided inertia at the onset of labor, there may be failure of the powers of the mother from

early exhaustion and fatigue, and we get the benefit of the quinia in diminishing this tendency and also in promoting the condensation of the uterine fiber after the delivery of the placenta, thus lessening the dangers of *post-partum* hæmorrhage and the annoyances of the after-pains so commonly resulting from a slow condensation of the uterine muscle."* He recommends the bisulphate in a fifteen-grain dose, which he declares acts altogether beneficially as a stimulant to the normal uterus. The other agents mentioned as possessing direct or incidental ecbolic properties are now chiefly of historic interest.

Irregular Pains in the Second Stage of Labor.—In many cases the pains maintain their normal quality until the completion of the first stage of labor and the descent of the head to the floor of the pelvis. When in the second stage of labor the pains become inefficient and lose their expulsive character, the non-advance of the head is usually attributed to a rigid perinæum. But it is a matter of every-day experience that with really good pains and normal head mechanism the perinæum speedily loses its rigidity. Of course, it is not denied that in primiparæ the organic changes which effect the softening of the perinæum need for their accomplishment relatively stronger pains than in multiparæ. The faulty action of the expellent forces in the second stage is due either to exhausted nerve-power or to excessive uterine retraction. In the former case, labor becomes powerless from the feeble character of the pains; in the latter, it results from the withdrawal upward of the uterine muscle, and the consequent lessening of the intra-uterine pressure. These cases of retraction are worthy of special consideration. Thus, Hofmeier† found in a number of instances where the head rested on the pelvic floor that the contraction ring, which was made out by palpation through the abdominal walls, was situated at from five to seven inches above the symphysis pubis, so that the contractile portion of the uterus covered not more than one third of the fœtus. Under such circumstances, while the patient suffers from intense pain, the contractions of the partially emptied uterus do not possess the force to overcome the resistance of a rigid perinæum.

Treatment.—In all cases of protracted second stage, before deciding upon the existence of uterine irregularity, both the bladder and the bowels should be emptied, and care should be taken to exclude the existence of obstruction from the bony pelvis. If the only resistance to be overcome is that furnished by the soft parts, weak pains should be re-enforced by the action of the abdominal muscles. After rotation of the head is completed, a new *vis a tergo* may be supplied by pressure applied to the breech through the abdominal walls after the method

* Albert H. Smith, Retarded Dilatation of the Os Uteri in Labor, p. 27.

† Hofmeier, Ueber Contractionsverhältnisse des kreissenden Uterus, Ztschr. f. Geburtsh. u. Gynæk., Bd. vi. p. 164.

of Kristeller, or by the modified form of expression recommended by Bidder.* According to the latter, the physician should stand to the left of his patient, and grasp the breech of the fœtus with the right hand; he should then raise the breech and fix it in such a position that the pressure applied will be best transmitted through the spinal column to the cephalic end—a point to be determined by the fingers of the left hand, which should likewise control the movements of the head during the period of expulsion. The force, the frequency, and the length of the acts of expression should of course be decided by the judgment and experience of the operator.

Where the movements of flexion and rotation have been imperfectly performed, little is to be expected from any of the forms of expression. The available remedies are then ergot and the forceps. Of these, the advantages of safety and celerity are all on the side of the forceps. Many practitioners, however, who have observed that in practice ergot often acts likewise with speed and safety, accord to it a large measure of confidence. But along with these more fortunate experiences there is a shady aspect to be remembered. When the tardy labor is due to tonic retraction, the use of ergot is calculated to aggravate the sources of delay. In other cases tonic retraction is the direct result of ergotic action, and, as a consequence of restricted utero-placental circulation, the life of the fœtus is jeopardized. When, therefore, the drug is used, the heart-sounds of the fœtus should be carefully watched, and, with the first signs of failing force, the forceps should be applied to rescue the child from the impending danger of asphyxia.

Note on the Use of Ergot in Parturition.—*Secale cornutum*, or ergot, the active principle of which is ergotin, according to Buchheim,† and ergotic acid, according to Zweifel,‡ is universally acknowledged to increase the frequency, length, and power of the uterine contractions during parturition, and to finally induce a tetanic condition of the uterine muscular fibers. Its action upon the unimpregnated uterus is the same in kind, but less marked in degree, and of less constant occurrence. Kobert,# on the other hand, denies the ecbolic properties of either of those constituents. He maintains that it is cornutin, which excites the uterine contractions, and that the abortifacient element is sphacelin acid, to which also the tetanic rigidity produced by ergot is due. The views of high authorities in regard to the manner in which these effects are produced present irreconcilable differences. Wernich‖ attributed the ecbolic properties of ergot to irritation of the uterine nervous centers, induced by

* E. Bidder, Zur Beurtheilung der Kristeller'schen Expressionsmethode bei Kopflagen, Ztschr. f. Geburtsh. u. Gynaek., Bd. iii, p. 241.

† Buchheim, Schmidt's Jahrb., vol. clxiv, p. 12.

‡ Zweifel, Ueb. d. Secale corn., Arch. f. exp. Pathol., vol. iv, 1875, p. 407.

Kobert, Arch. f. exp. Pathologie u. Pathol., Bd. xviii, p. 316.

‖ Wernich, Einige Versuch. üb. d. Mutterk., Beiträg. z. Geburtsh., vol. iii, 1874, p. 102.

arterial anæmia of the spinal cord and of the uterine tissues. This anæmia is referred by him to loss of tone in and dilatation of the veins, whereby venous congestion, leading to secondary arterial anæmia, is produced.* Other observers assume a primary contraction of the capillaries, with a consequent increased arterial pressure, as the source of the anæmic irritation of the nerve-centers; while still others believe direct stimulation of the uterine muscular fibers by the ergot to be the cause of their exaggerated contractility.†

Köhler refers the uterine contractions produced by ergot to increased irritability of the peripheral nerves, in conjunction with anæmia of the spinal cord.‡ These conflicting views pertain chiefly to points of purely theoretical interest, and need not prevent the obstetrician from obtaining a clear conception of his duty in the practical administration of ergot. The above-mentioned incontrovertible facts concerning its operation suffice to guide the physician in the employment of this useful drug, even if he be unable at present to definitively decide regarding the exact mechanism of its physiological action.

Ergot should never be exhibited during the first stage of labor, because the tetanic uterine contractions, which it substitutes for the normal rhythmical ones, tend to prevent the further dilatation of the os uteri and to deprive the fœtus of its blood-supply through the constriction of the uterine vessels. Should the membranes have ruptured before the termination of the first stage, the administration of ergot would endanger the life of the fœtus by causing undue pressure to be exerted upon the umbilical cord. We should also abstain from the use of ergot during the second stage, unless it seem necessary as a prophylactic against *post-partum* hæmorrhage. Even under these circumstances it should never be administered if there be the slightest mechanical obstacle to delivery, or if the fetal head be high up in the pelvic canal. Spiegelberg# insists upon the necessity of carefully observing the fetal heart after the use of ergot, in order that instrumental delivery may, in case of threatened asphyxia, be promptly resorted to. Benicke records twenty-seven cases in which ergot was administered during the second stage on account of inertia uteri. Spontaneous delivery occurred in only seven of these cases.‖ Ergot is not specially adapted to the arrest of hæmorrhage accompanying abortion. In these cases, and in hæmorrhage caused by retained shreds of the fetal envelopes, the appropriate treatment consists in the tampon and in subsequent complete evacuation of the uterine cavity. The only imperative exhibition of ergot is presented by the occurrence of *post-partum* hæmorrhage resulting from uterine atony.^ The unyielding, tetanic uterine contractions which it produces act most beneficently by occluding the orifices of the bleeding vessels. Even under these circumstances it should, however, be withheld until after the expulsion of the placenta, lest the uniform uterine contractions lead to its prolonged retention or interfere with manual efforts for its extraction.

Irregular Pains in the Third Stage of Labor.—The tardy expulsion of the placenta, due to atony of the uterus, is of rare occurrence

* Wernich, *op. cit.*, p. 97.

† Benicke, Ueb. Anwend. d. Mutterk. in d. Geburtsh., Ztschr. f. Geburtsh. u. Gynaek., vol. iii, 1878, p. 174.

‡ Köhler, Schmidt's Jahrb., vol. clxiv, p. 14.

Spiegelberg, Lehrb., p. 414.

‖ Benicke, *op. cit.*, p. 178.

^ Schroeder, Lehrb., fifth edition, p. 471.

when the Credé method of expression is uniformly practiced. As, in relaxed conditions of the uterus, blood pours from the patulous mouths of the torn utero-placental vessels into the fundus, a free external discharge of blood follows of necessity whenever contractions are excited—a fact to be borne in mind by an unpracticed obstetrician, lest he mistake the simple conversion of an internal into an external hæmorrhage for one produced by the manipulations which have been recommended. The whole subject of atony in the third stage is, however, so closely associated with the occurrence of *post-partum* hæmorrhage that its specific consideration will be reserved for separate study in connection with the hæmorrhages which take place during and subsequent to labor.

After the birth of the child, retraction of the uterus is Nature's safeguard against hæmorrhage. As a result of the abuse of ergot, or, in other cases, from an abnormal adherence of the placenta, such an extreme degree of retraction may be reached before the completion of the third stage as to lead to the imprisonment of the placenta within the uterine cavity. In these cases complete retraction in the body of the uterus is prevented by the presence of the placental mass. Below the latter, where no obstacle is opposed to the shortening of the muscular fibers, a constriction results. The stricture is most pronounced at the contraction ring. The lower uterine segment and the cervix proper are usually in a sub-paralytic condition, and widen from above downward to the vaginal insertion. From the shape thus imparted to the uterus this condition is generally known as an "hour-glass contraction." When met with for the first time, it is apt to prove extremely puzzling. In following the cord upward, its continuation through the stricture is sometimes overlooked. In several cases I have known the pulpy mucous membrane of the lower segment to be mistaken for an adherent placenta, and have been, in consequence, summoned to assist in its removal.

Treatment.—By patient waiting, relaxation of the stricture usually takes place spontaneously. The result may be promoted by the hypodermic injection of morphine, combined with atropine. It is not, however, altogether safe to leave the patient before the expulsion of the placenta has taken place; for, exceptionally, the muscular fibers of the body of the uterus may relax prior to those of the lower segment, and thus hæmorrhage may result. Injections of ice-cold water were recommended in such cases by Seyfert, as tending not only to restrain hæmorrhage, but to promote regular expulsive uterine action. Forcible dilatation is rarely necessary, and should be reserved for hæmorrhages of an alarming character. In nearly all cases, however, it is practicable, even in extreme examples, to extract the placenta in a short time without force or violence. The plan I have followed of late years, with uniform success, consists in introducing the index and

middle fingers, with the whole hand in the vagina, to the point of constriction. Then, by pressing the uterus downward, the fingers are brought in contact with the placental border. Now, it is only necessary to draw a single cotyledon into the canal to render the further extraction a matter of certainty. Under the pressure of the soft placental mass the stricture relaxes slowly. By combining expression with slight traction, the delivery is surely accomplished. The principal difficulty of the operation lies in the manipulations needful to bring the placenta at the outset to the point of stricture, but this difficulty can be pretty certainly overcome by patience and the determination to succeed. During the period of withdrawal the operator should be content with a very slow progression, proportioned to the yielding of the stricture; otherwise, the presenting portion of the placenta tears away, when the labor expended is lost.

Painful Labors.—In nearly all forms of abnormal uterine contractions the pain of labor reaches a pathological degree of intensity. Especially we have had occasion to call attention to the intolerable suffering in cases of long-continued reciprocal pressure between the uterus and its contents.

But acute suffering sometimes attends upon the preliminary stages of labor. During the latter days of pregnancy in primiparæ, often for a few hours only preceding the advent of true labor-pains in multiparæ, contractions occur which normally scarcely attract the attention of the patient. In rare instances, however, the suffering they occasion is extreme. In hysterical women these preliminary pains are often of an agonizing character, rendering it necessary to resort for their relief to such palliatives as the warm bath, opium, and chloroform.

But, even where hysteria does not exist as a cause, the pains may be so severe, while the cervix has still its normal length, that the woman believes herself in labor, and, indeed, the contractions are as painful as in actual labor. There are no febrile symptoms indicative of inflammation either of the uterus or of its appendages. The pain is like that in muscular rheumatism. Though the term rheumatism of the uterus is often applied to this condition, its pathology is uncertain. It is very probable that practitioners confound together, under the foregoing title, a number of distinct affections, such as hysterical hyperæsthesia, intestinal irritability, and the early stages of inflammation. Excluding these morbid conditions, there remains a class of cases practically important from the disappearance of the pain upon the induction of intense diaphoresis. Patients who for days have been treated with hypodermic injections of morphine with only moderate results are often relieved as if by magic by placing them in a warm bath, and then covering them with blankets, giving in addition hot drinks and Dover's powder, until they become bathed in abundant perspiration.

It is often difficult toward the close of pregnancy to distinguish between colic-pains due to fecal accumulation or the presence of gases in the stomach and intestines, troubles to which pregnant women are especially disposed, and uterine contractions of a painful character. Indeed, in the former case the uterus becomes involved to some extent, so that the cervix is felt during a cramp to simultaneously harden. Moreover, after labor has actually begun, it may become complicated by colic-pains, which exercise in turn a suspensive influence upon parturition. But the colic-pains are themselves intermittent, and are therefore liable to be mistaken for those of labor. Thus, it is possible to become involved in perplexities which time alone can solve. Even when we have made out the diagnosis of "false labor," and give an opiate for the relief of the patient, it may happen that the first result of quieting the pain may be the acceleration of labor. When this does not occur, we should guard against the return of the trouble by clearing out the bowels by purgatives or enemata.

In normal labors, the pulse becomes more rapid at the beginning of each pain, and continues to increase in frequency until the pain has reached its acme, after which a gradual declination follows. But sometimes labor is attended by marked febrile symptoms. There exist rapidity of the pulse between the pains and a continuous elevation of temperature. Now, if, at the same time, the uterine contractions are the source of extraordinary suffering, there is strong reason for suspecting that labor is complicated by inflammatory conditions of the organs concerned in parturition. Thus, a latent pelvi-peritonitis may be converted into the acute form by the several acts which comprise normal labor, or the prolonged tonic contraction of the uterus upon the fœtus after the rupture of the membranes, especially in neglected shoulder presentations and in contracted pelves, may give rise to inflammatory affections in the uterus itself. Again, in other cases, a salpingitis, especially if of *the purulent* variety, may become the starting point of dangerous local or general peritonitis. In either case the coexistence of intense pain with febrile symptoms should awaken serious apprehensions. Especially ought we to be upon our guard against the treacherous lull in the symptoms that, as a rule, takes place when labor is at an end. After a day or two we may expect a chill and the return of the fever. In the early stages of metritic and perimetritic trouble, a ten-grain dose of calomel often exercises a beneficent action in arresting the disease. Where labor has so far advanced that the induction of artificial diarrhœa is rendered impracticable, opiates, though of inferior value, soothe the pain, and are our next most valuable resource.

CHAPTER XXV.

CONTRACTED PELVES.

Varieties.—Frequency.—Diagnosis.—Pelvic measurements.—Forms of the contracted pelvis.—Justo-minor pelves.—Flattened non-rachitic pelves.—Rachitic flattened pelves.—Generally contracted, flattened pelves.—Irregular forms.—Pseudo-osteomalacia.—Scholiosis.—Kyphosis.—Influence of contracted pelves during pregnancy and labor.—Influence upon the uterus.—Influence upon the presentation.—Influence upon the pains.—Influence upon the first stage of labor.—Influence upon the mechanism of labor.—Effects of pressure upon the maternal tissues.—Influence upon the fetal head.—Effects of pressure upon the integuments; upon the cranium.—Prognosis.

In contracted pelves sometimes a single diameter, sometimes all the principal diameters are reduced below the normal average. The relative proportion of the parts may be to a considerable extent preserved, or the pelvis may have been distorted by special morbid conditions, giving rise to unequal development and changes of outline. These peculiarities embarrass all attempts at classification. Still, the study of the subject is greatly simplified by the fact that the diminished space is, in the great proportion of cases, located chiefly at the brim. Aside from these, there remain a variety of irregular forms of rare occurrence, each requiring a separate description and plan of treatment.

It is to those cases in which the narrowing is chiefly at the brim that the term "contracted pelves" is generally applied. The other forms are all specially designated by some qualifying adjective defining their character.

Contracted pelves proper are divided into—

1. The pelvis æquabiliter justo-minor, in which all the diameters, from the brim to the outlet, are diminished in very nearly equal measure.

2. The flattened pelvis, contracted specially in the conjugate diameter. In this form the transverse diameter may be normal, or may be diminished. Thus, we distinguish—

a. Simple flattened pelves (transverse diameter normal).

b. Flattened, generally contracted pelves (narrowing in the transverse as well as the conjugate diameter).

As it is rare to find two pelves possessing the same measurements, the question arises as to the degree of antero-posterior shortening which suffices to distinguish the contracted from the normal pelvis.

It is often customary to consider the contracted pelvis simply as furnishing a mechanical obstacle to the passage of the child's head; but this is to overlook a great variety of very important modifications

to which it gives rise during pregnancy and labor. These remoter influences are often observable in cases where labor, if considered from the standpoint of length alone, would be regarded as normal.

Michaelis* and Litzmann,† whose investigations furnish the basis of modern opinion regarding the contracted pelvis, place the limit at three and a half inches for the simple flattened pelvis, and at four inches for those likewise diminished in the transverse diameter. Yet even above these limits the action of the narrow pelvis is not rarely manifested in disturbance of the normal mechanism of labor.

In Germany, Litzmann, Michaelis, Spiegelberg,‡ and Schroeder place the average frequency of contracted pelves at fourteen per cent, and in my own field of experience, in the Emergency and Maternity Hospitals of New York city, the inmates of which are, however, almost entirely of foreign birth, every variety and degree of pelvic deformity finds abundant illustration. In our native American women abnormal pelves are rare. I frequently hear from country physicians who attend lectures at the Bellevue Hospital Medical College that, in long years of practice, they have never met with a single instance. Yet it is impossible to study the cases of vesico-vaginal fistulæ reported by Dr. T. A. Emmet# without arriving at the conclusion that the existence of contracted pelves is frequently overlooked. Certainly the immunity of American women is by no means so absolute as to justify the neglect in which the study of pelvic deformity has so generally fallen.

The Diagnosis of Contracted Pelvis.—The diagnosis of pelvic deformity is based upon direct examination. Certain facts in the previous history of the patient are often of substantial value in the way of confirmatory evidence, or by directing attention to the probable existence of deformity.

Previous History.—Inquiry should be instituted regarding the occurrence of rickets in early childhood, and especially in this connection as to the period of the appearance of the teeth. Late dentition is an ordinary sign of imperfect bone formation. A cross baby, bottle-fed or improperly nursed, suffering from repeated attacks of indigestion, from restlessness at night, and profuse perspirations, who cuts the first incisor teeth in the second year, has presumptively had rickets. A history of this nature, even in the absence of the grosser evidences of rickets, such as the square head, the pigeon-breast, the tumefied abdomen, small stature, spinal curvature, enlarged joints, and incurvation of the long bones of the extremities, is to be regarded with suspicion. Data of the kind mentioned are, however, often difficult to obtain, and

* Michaelis, Das enge Becken, Leipsic, 1865.

† Litzmann, Die Formen des Beckens, Berlin, 1861.

‡ Spiegelberg, Lehrbuch, 1878, Bd. ii, p. 426.

Emmet, Vesico-Vaginal Fistula, William Wood, 1868.

it should be borne in mind that not every case of mild rachitis is followed by pelvic narrowing.

Instruction may likewise be obtained from the history of previous labors. Though a protracted and difficult labor is by no means uncommon in well-formed primiparæ, it should stimulate us, both during parturition and subsequent to delivery, to make a careful investigation as to the capacity of the pelvis. A pendulous abdomen and faulty presentations and positions of the fœtus occur with much greater frequency in contracted than in normal pelves.

Certain of the rarer deformities proceed from inflammations between the sacro-iliac bones and at the hip-joint, from inequalities in the length of the limbs, and from spinal distortion when these difficulties occur in early childhood.

Pelvic Measurements.—The examination should be made with the patient upon her back, placed preferably upon a hard table covered by a folded blanket, or a woolen comforter. The head and shoulders should be moderately elevated, the knees should be flexed, and the pelvis brought as near to the edge of the table as possible.

Facility in the recognition of abnormal conditions can only be acquired by making it a habit to note the general features of the pelvis in every case of labor which is committed to our charge. By experience we acquire a tolerably distinct idea of the relative thickness of the bones, the inclination of the ilia to the horizon, the height of and the angle formed by the symphysis pubis, the size and character of the pubic arch, the length, breadth, and curvature of the sacrum, the position of the promontory, and the distance between the ischia.

Fig. 200.—Baudelocque's pelvimeter.

More exact information is derivable from direct measurements between different prominent points in the pelvis. Various pelvimeters have been devised to facilitate the required measurements. Those for determining the distance between certain external points are alone of practical value. For this purpose the circle of Baudelocque is the one I have most constantly employed. It requires to be used with caution on account of the spring of the metallic arms. Schultze's instrument possesses the advantages of greater firmness and portability. The points selected for measurement should be bony prominences, easy of recognition, and not covered by soft parts. They should be such as to allow us

to form at least approximative conclusions relative to the diameters of the small pelvis. Experience shows us that, judged by these rules, three measurements only are possessed of real importance, viz., the distances between the anterior superior spinous processes, the distances between the crests of the ilia, and the external conjugate diameter.

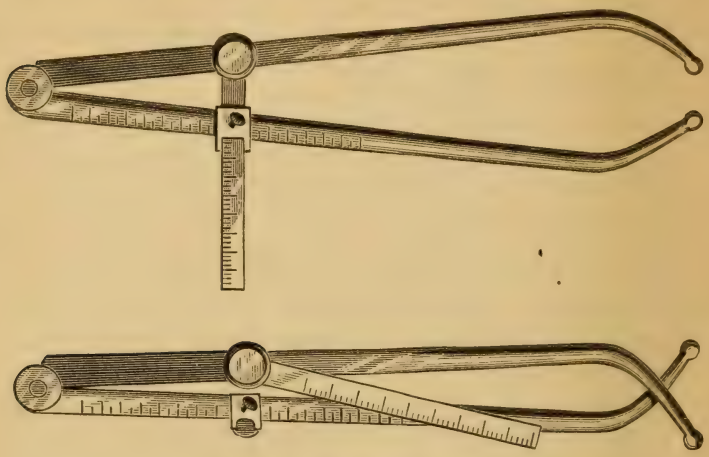


Fig. 201.—Schultze's pelvimeter.

In measuring the distances between the anterior superior spinous processes, the accoücheur should stand by the side of his patient, and, holding the arms of the pelvimeter between the thumb and fingers, apply the points of the instrument to the spines external to the insertion of the sartorious muscles. The points should then be pushed backward a number of times along the outer edge of the crests of the ilia, until, after a few trials, the greatest distance between the crests has been determined. The average distances thus obtained are nearly ten and a quarter inches between the spinous processes, and eleven and a half inches between the crests of the ilia. A pelvis in which these measurements are equal, or in which the relations are inverted (i. e., where the distance between the spinous processes is greater than that between the crests of the ilia), is rachitic in character. In rachitic pelves of the second variety mentioned it is customary to select, in measuring the distance between the crests, points situated two and a half inches posterior to the spinous processes.

Any considerable falling below the normal average in these two diameters would warrant the diagnosis of transverse shortening in the inner dimensions of the small pelvis. Deductions as to the degree of shortening should, however, be made with caution, as the relations between the diameters of the large and small pelves depend upon such variable factors as the thickness of the bones and integuments and the height and inclination of the ilia to the horizon.

In measuring the external conjugate diameter the patient is turned upon her side; one extremity of the pelvimeter is then placed upon the fossa just beneath the spinous process of the last lumbar vertebra, while the anterior point is made to rest upon the middle of the upper border of the symphysis pubis. The length of the external conjugate, or, as it is sometimes termed from its author, the diameter of Baudelocque, is normally about eight inches. Baudelocque thought that by deducting three inches from the external conjugate in spare women, and three and a quarter inches in women of a fleshy habit, the conjugata vera could be determined. Litzmann has, however, strikingly shown the fallacy of Baudelocque's deduction. In thirty cases, where he had an opportunity to compare the measurements of the external conjugate with the length of the internal conjugate as determined subsequently by *post-mortem* examination, he found the mean amount to be deducted was about three and a half inches. However, the amount in individual cases widely varied, owing to differences in the thickness of the bones and integuments, the maximum amounting to nearly five inches, while the minimum did not exceed two and three fourths inches. But, while the external conjugate does not enable us to estimate to a fraction the length of the antero-posterior diameter of the pelvic brim, it furnishes useful information as to the existence in general of flattening. Thus, if the diameter of Baudelocque measures less than six and one fourth inches, it may be assumed that the pelvis is flattened. If the pelvis measures less than seven and a half inches, flattening may be assumed in half the cases. Above seven and a half inches, antero-posterior shortening is very exceptional.*

For internal measurements, the only practical pelvimeter is the hand of the accoucheur. To be sure, it can only determine with exactitude the diagonal conjugate, i. e., the distance from the lower border of the symphysis pubis to the promontory; but from the diagonal conjugate it is possible to calculate the conjugata vera with a closer degree of accuracy than is obtainable by means of any of the ingenious instruments designed to measure directly the diameters of the brim.

To ascertain the diagonal conjugate, the index and middle fingers of the left hand should be introduced, well oiled, into the vagina. By pushing the posterior vaginal wall backward, the points of the fingers are made to reach the sacral vertebræ. Then, following the sacrum upward, the promontory is reached. To do this it is necessary to sink the elbow, and give to the fingers a nearly vertical direction. The resistance of a rigid perinæum and the vaginal wall is best overcome by continued, steady, upward pressure. It is often possible by this method to reach the promontory in even normal pelves. During the examination the patient should be requested to raise up her hips. The

* Litzmann, Ueber die Erkenntniss des engen Beckens, Volkmann's Samml. klin. Vortr., No. 20, p. 148.

promontory is recognized partly by its convex surface, and partly by the width of the cartilage which intervenes between it and the adjoining lumbar vertebra. In practice there are two possible sources of error, viz.: an angle may form between the first and second sacral vertebræ where the union has been incomplete, producing a "false promontory" beneath the true one; or the upper surface of the first lumbar vertebra may project in such a way as to be mistaken for the promontory in cases where the latter, as sometimes happens, forms with the spinal column a very obtuse angle.* Such deviations are not without practical interest, as the prognosis is rendered less promising when the head, in place of a single point of contact, has to overcome the resistance offered by the surface of an entire vertebra.

The measure of the diagonal conjugate is taken by pressing the middle finger firmly against the most salient portion of the promon-

FIG. 202.—Normal inclination of the symphysis pubis. (Spiegelberg.)

FIG. 203.—Diminution of angle between symphysis and pelvic brim.

FIG. 204.—Increase of angle between symphysis and pelvic brim.

tory, while the radial edge of the hand or index-finger is raised to the *ligamentum arcuatum*. The point of contact with the latter is then carefully marked with the nail of the index-finger of the right hand. It is desirable in withdrawing the fingers that they maintain, as nearly as may be, the position assumed at the time of measurement. Finally, with a small rule, the length from the mark of the nail to the tip of the finger is readily ascertained.

In calculating the length of the conjugata vera from the measure thus gained, it is necessary to reconstruct the triangle formed by the two conjugates and the symphysis pubis. The diagonal conjugate is the longest of the three sides. The length of the conjugata vera depends on the height and inclination of the symphysis pubis and the

* LITZMANN, Ueber die Erkenntniss des engen Beckens, Volkmann's Samml. klin. Vortr., No. 20, pp. 152, 153.

degree of elevation of the promontory above the symphysis, as may be readily seen by reference to the diagrams.

The height of the symphysis pubis may be determined by the finger through the anterior vaginal wall. When the symphysis does not measure above one inch and a half, the subtraction of two thirds of an inch from the diagonal diameter will, under ordinary circumstances, furnish very nearly the conjugate. When the symphysis exceeds one inch and a half, three fourths of an inch should be deducted.*

The inclination of the symphysis pubis to the plane of the brim and the height of the promontory above the upper border of the pubes can only be estimated. When any unusual deviations in either of these regards are found to exist, some special allowance would need to be made by way of compensation. It is just here that judgment and experience furnish the best safeguards against vital inaccuracies.

In thin persons during the non-pregnant state the promontory can sometimes be easily reached through the abdominal walls, and an estimate made of the conjugate by deducting, from the distance thus obtained between the promontory and the symphysis, the supposed thickness of the intervening tissues.

The transverse diameters of the pelvic brim and cavity can be neither directly measured nor calculated with any degree of certainty from other measurements.

There are certain other dimensions which we find useful to determine in the rarer forms of distortion, and which will be mentioned in their proper connections. For the three forms of contracted pelvis which at present engage our attention, four measurements alone are of practical value—viz., the distance between the anterior superior spinous processes; the distance between the crests of the ilia; the external conjugate; and the conjugata diagonalis.

The Three Principal Forms of Contracted Pelvis.

The Pelvis Æquabiliter Justo-minor, or Symmetrically Contracted Pelvis.—This, the rarest of the three forms, presents to the casual view the appearance of a normal pelvis, except that the diameters from the brim to the outlet are reduced in nearly equal measure. We distinguish two varieties of this pelvis: 1. In the commoner variety the woman may be of small, medium, or large stature, and her figure thickset, or, on the contrary, graceful and slender. Nothing in either her size or carriage is indicative of any abnormal condition. The pelvic bones themselves, both in their structure and in their connections with one another, are free from all traces of morbid action. They are simply below the standard size. The pelvis as a whole is of the feminine type. Litzmann has shown, however, that in the *justo-minor* pelvis

* Spiegelberg, *op. cit.*, p. 433.

the relations of the different parts to one another are not, as a rule, absolutely the same as in the normal pelvis. Thus, there is diminished width of the sacrum, due in special degree to the small size of the alæ; the rotation forward of the promontory and the curving of the lower extremity of the sacrum are less pronounced; the concavity of the sacrum in the transverse direction is increased; the posterior sacral surface is nearly on a level with the posterior superior spinous processes in place of sinking forward between the ilia; the height of the anterior and lateral walls is proportionately lessened; and, finally, there is often an increase in the angle which the symphysis pubis forms with the conjugate.*

These peculiarities point to a premature arrest in the development of the bones, whereby the pelvis retains something of the infantile type. The causes of arrest are in most cases traceable to general disturbances of nutrition during early childhood, such as scrofula and chlorosis, to rickets, which in place of leading to deformity exceptionally exerts its influence in the suspension of bone-growth, and in rare cases to the influence of hard labor and the carrying heavy weights before the completed development of the body. A few cases in which no morbid conditions can be elicited from the history of the patient may perhaps be referred to some original defect in the primitive material from which the bones were built up. Cases have been reported in which this anomaly appeared to be hereditary.†

2. In veritable dwarfs the diminutive size of the pelvis may simply correspond to the Lilliputian proportions of the entire skeleton. These so-called dwarf pelves—*pelves nanæ*—are of the regular feminine type, but the bones are slight, and united, as in the child, by cartilage. They are extremely rare. In pelves of this variety the highest degree of contraction is observed.‡

Diagnosis.—In the *justo-minor* pelvis all the external diameters are diminished. At the same time rickets is excluded by the normal relations existing between the spines and the crests of the ilia (*vide* p. 475). The diagonal conjugate is lessened. In estimating the conjugata vera it is necessary carefully to notice the height of the promontory and the inclination of the anterior pelvic wall, as these are sometimes exaggerated and call for an increase in the amount to be deducted.# By careful palpation of the two sides of the pelvis with the

* Litzmann, Die Formen des Beckens, Berlin, p. 40.

† Michaelis, Das enge Becken, herausgegeben von Litzmann, p. 190; *vide* likewise, Löhlein, Zur Lehre vom Durchweg zu engen Becken, Ztschr. f. Geburtsh. u. Frauenkr., Bd. i, p. 53.

‡ There is a third form of justo-minor pelvis, which is the concomitant of undeveloped organs of generation. As it occurs only in sterile women, it possesses no obstetrical interest.

On the contrary, owing to the shortness of the symphysis pubis, as a rule, the average amount to be deducted is rather less than in normal pelves. Löhlein Kunst-

half-hand introduced into the vagina, the fact but not the degree of transverse shortening may be recognized. Still, in this way the existence of extreme contraction would be noticed.* Löhlein maintains

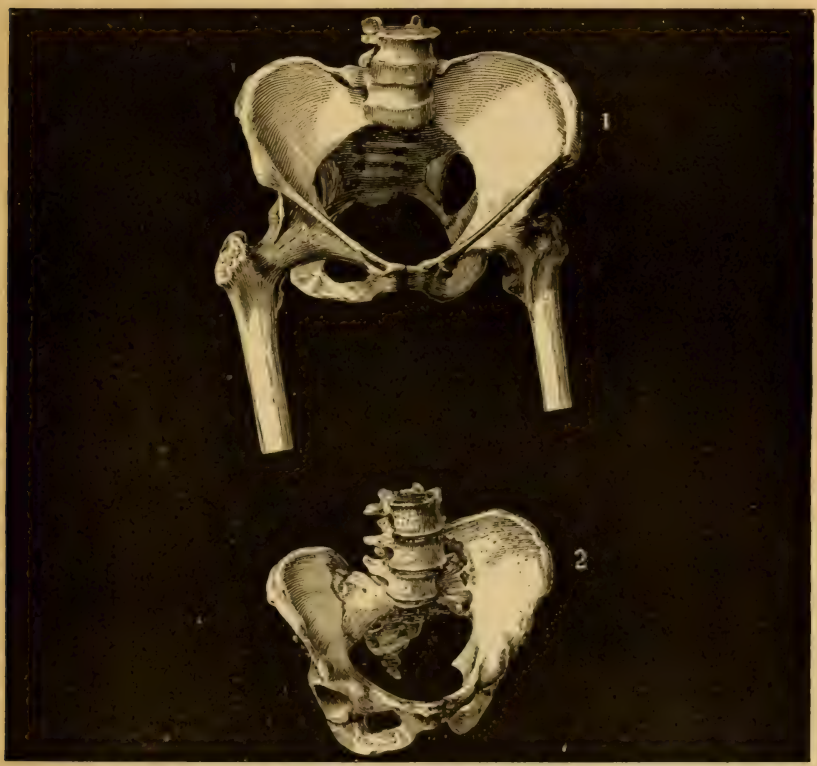


FIG. 205.—Specimens from the Wood Museum (Bellevue Hospital). Drawn on same scale. No. 1. Normal pelvis. No. 2. Justo-minor pelvis.†

that the addition of four fifths of an inch to the distance from the lower border of the ligamentum arcuatum and the upper border of the great sciatic notch, which can be measured by the finger without great

hülfe bei der allg. Beckenenge) found the average in eighteen cases was three fifths of an inch.

* LÖHLEIN, Zur Becken-Messung, Ztschr. f. Geburtsh. und Gynaek., vol. xi, part i, p. 33.

† Primipara, aged twenty-three. In labor three days previous to my seeing her. Waters all escaped. Large scalp-tumor reaching nearly to vulva. Cervix rigid. Os one third dilated and pushed down by scalp-tumor. Forceps tried. Afterward perforation and craniotomy. Chin tilted and head brought through the pelvis by the fronto-mental diameter. Patient died on third day. Extensive marks of pressure in the bladder opposite pelvic rami. Small circular perforation of uterus opposite promontory. Conjugate diameter three inches. Transverse diameter of brim four and a half inches. Slight Naegele obliquity on left side. Patient was fifty-nine inches in height, and presented no signs of rickets.

difficulty, furnishes a close approximation to the length of the transverse diameter. In ordinary cases, it is fortunately safe to base practice upon the length of the antero-posterior diameter.

Flattened Pelvis.—We have seen that the characteristic of this form is a shortened conjugate diameter. The transverse diameter remains at the same time normal, or may sink below the standard. A special distinction is likewise to be made between the flattened pelves of non-rachitic and rachitic origin:

1. The flattened non-rachitic form is the most frequent variety of contracted pelvis. At a first glance, or previous to measurement, it often produces the impression of a normal, well-formed pelvis. It is occasioned by a sinking of the sacrum downward and inward between the two ilia. As this movement takes place without any forward rotation of the promontory, the antero-posterior shortening is not confined to the brim, but extends throughout the entire pelvic cavity. Extreme contraction is uncommon, the length of the conjugate rarely falling below three inches. The flattening is of necessity associated with a compensating increase in the transverse diameter. As, however, the flattened non-rachitic pelvis is usually from the outset of small size, the compensation hardly suffices to give to the transverse diameter more than the normal dimensions. Indeed, it is not infrequent to find a slight lessening in the transverse diameter associated with antero-posterior contraction.

There is nothing definitely settled regarding the etiology of this deformity. It has been attributed to lifting and carrying heavy burdens before the age of puberty, to incompletely developed rickets, and to retarded development.

During life it is not easy to distinguish between this form and that of the symmetrically contracted pelvis. In both the external signs of rickets are absent, the relations between the spines and crests of the ilia normal, and in both all the external diameters may be somewhat diminished. The stature of the individual furnishes no clew; for, though both forms occur rather more frequently in diminutive persons, there are numerous exceptions to the rule. The sinking of the sacrum between the ilia is not easy to recognize. In a well-marked example, however, the relatively greater shortening of the conjugata externa and the diagonal conjugate,* with the difficulty of palpating the inner surface of the pelvic lateral walls, furnish the prominent points for guidance. Sometimes, when no bony union has formed between the first and second sacral vertebræ, a double promontory may be left.

* In reckoning the true conjugate from the diagonal diameter, the same reduction needs to be made as in the normal pelvis, for, though the outward slant of the symphysis is increased, this is compensated for by the diminished height of the symphysis and low position of the promontory. (Litzmann, Volkmann's Samml. klin. Vortr., No. 20, p. 160.)

2. The rachitic form of flattened pelvis presents the following characteristics:

The bones are of small size, but usually of normal texture. Sometimes, however, they are thin, and even translucent, while in other instances they may be unusually compact and thickened. The ilia are flattened, and run in a nearly horizontal direction. The anterior superior spinous processes flare outward, so that the distance between them differs little from that between the widest points of the crests. The promontory projects inward toward the symphysis pubis. The upper portion of the sacrum sinks inward between the ilia, and lies farther in front of the posterior superior spinous processes than in the normal pelvis. The upper portion, too, is directed nearly horizontally backward, while the extremity, usually at the fourth or fifth sacral vertebra, is bent sharply forward. The anterior sacral surface loses its transverse concavity, and becomes either flat from side to side, or convex from the bulging forward of the sacral vertebræ. The anteroposterior shortening of the brim is accompanied by a compensating increase in the transverse diameter. As, however, the rachitic pelvis is originally undersized, the transverse diameter rarely exceeds normal dimensions. The horizontal rami of the pubes are flattened, and the acetabula are directed to the front. The cartilage of the symphysis pubis generally projects inward, the pectineal line is often unusually sharp, and at times terminates at the insertion of the psoas muscle in a projecting spine. Below, the ischia diverge from one another, and the arch of the pubes is widened.

Fig. 206.—Flattened rachitic pelvis. (Wood's Museum.)

The result of these changes is to produce a shallow pelvis, with contraction at the brim and widening at the outlet. The shape of the brim varies between a long ellipse and that of a heart or kidney, the different degrees of variation depending upon the extent of the displacement forward of the promontory. Externally, owing to the horizontal position of the sacrum, a depression exists in the lumbar region, the sulcus between the nates is broad and superficial, and the anal orifice is exposed to view.

To appreciate the rachitic pelvis, it is necessary to bear in mind the changes wrought by rickets in the bony structures. In the physiological growth of the pelvic bones, new cell-elements develop beneath the

periosteum and adjacent to the cartilaginous borders upon the articular surfaces. These cell-elements promptly ossify, and thus provision is made for the increase of the bones in extent and thickness. Simultaneously with the formation of the new bone, medullary spaces are produced in the bony tissues by a process of absorption. Now, in rickets, while the new cell-elements are deposited in such numbers that the preparatory layer is often five to ten times the normal thickness, the process of ossification is suspended or imperfectly performed. Thus, the rachitic pelvis consists of a number of more or less firm, bony masses, covered with soft osteoid layers, with broad cartilaginous borders at the articular surfaces. These changes combine to increase the pliability of the pelvis, and to retard its growth.

The pelvic deformity resulting from rickets is mainly due to the weight of the superimposed body. The pressure from above which the trunk exerts pushes the promontory forward toward the median line. At the same time the upper portion of the sacrum rotates upon its transverse axis, so that its posterior aspect is nearly on a line with the horizon. The bodies of the vertebræ sink downward between the flexile wings, whereby the concavity of the sacrum from side to side is effaced. The pliant border of the iliac articulation yields somewhat, and, as it is drawn inward by the sinking of the sacrum, the traction of the strong sacro-iliac ligaments approximates the posterior superior spinous processes to one another. The traction of the sacro-tuberous and sacro-spinous ligaments aids in hooking forward the lower extremity of the sacrum, though to this deformity the pressure exercised upon the end of the spinal column by the half-sitting, half-recumbent posture affected by rachitic children unquestionably contributes its part.

If we regard the sacrum as a fulcrum, and each os innominatum as a lever, it is evident that the traction of the sacro-iliac ligaments, under the pressure upon the sacrum from the trunk, would produce a separation of the innominate bones in front were it not for their firm union at the symphysis pubis. The result of these two counteracting forces is an increased incurvation of the bones at the point of weakest resistance, which is situated near the articular surfaces. In advanced rickets, where the bones are plastic and willowy, the linea arcuata is often bent at an angle, so that the greatest transverse diameter divides the pelvic brim into a posterior and anterior half. To the latter belong the acetabula, to the former the two ilia.

The outward direction of the anterior superior spinous processes is probably due in a measure to an arrest of development, as the S-shaped curve of the crests of the ilia does not normally develop until after the age at which rickets usually makes its appearance (Kehrer). The flattening of the ilia is partly due to the drag of the sacro-iliac ligaments, and partly to the action of the sartorii and gluteal muscles. The divergence of the ischia and the wide arch of the pubes are the product

of the increased transverse diameter, and the attachments of the rotator and adductor muscles of the thigh.*

The diagnosis of the rachitic form of flattened pelvis is easy, if the characteristic changes are kept in mind. The prominent features to which the attention needs to be directed are: the relations of the distances between the cristæ ilii and the anterior superior spinous processes (diminished difference, or distance, between the anterior superior spinous processes may equal, or even exceed, that between the crests); diminished distance between the posterior superior spinous processes; diminution of the external conjugate; the form and direction of the sacrum; the shape of the arcus pubis; and the marked projection of the promontory. A false promontory at the second sacral vertebra is not uncommon. The deduction to be made from the conjugata diagonalis in estimating the conjugata vera averages the same as in the normal pelvis. However, it is in rachitic pelves that the widest variations in this respect occur, making it specially necessary in each case to observe the height of the promontory and the length and direction of the symphysis pubis.

Flattened Generally Contracted Pelves.—In this variety we distinguish likewise a rachitic and non-rachitic form, the latter occurring rarely, the former with comparative frequency.

The non-rachitic form is apparently the joint product of a small justo-minor pelvis and the forces which lead to a sinking of the sacrum between the ilia. In these pelves a short symphysis and a low promontory contribute often to reduce greatly the difference between the diagonal and the true conjugate. During life it is difficult to distinguish it from the justo-minor pelvis.

The rachitic form is found usually in persons of small stature. It presents in a striking degree the marked peculiarities of the rachitic pelvis. The existence of transverse narrowing is recognized by the narrowness of the hips, by the ease with which, in internal examination, the side walls can be felt with the palmar surface of the half-hand, and by the modifications it produces in the mechanism of labor.

* While Litzmann (Die Formen des Beckens) and Schroeder (Lehrbuch der Geburtshülfe) lay special stress upon the weight of the body as the main factor in producing the deformities of rickets, Kehrer (Zur Entwickelungs-Geschichte des rachit. Beckens, Arch. f. Gynæk., Bd. v, 1872, p. 55) has shown that many of the changes characteristic of rickets occur in congenital cases—i. e., before the action of the weight of the trunk is brought into play. Kehrer refers the changes, therefore, in the main, to muscular action. Fehling (Die Entstehung des rachit. Beckens, Arch. f. Gynæk., Bd. xi, p. 173) ascribes the deformities in rickets to disturbances of growth and persistence of the fetal type. Engel (Wiener med. Wochenschrift, 1872, No. 40) sought to prove the deformities to be the result of partially arrested growth. J. Veit (Die Entstehung der Form des Beckens, Ztschr. für Geburtsh. und Gynæk., vol. ix, p. 347) furnishes strong evidence in favor of Litzmann's theory.

Irregular Rachitic Pelves.—For convenience' sake it seems desirable to attach to the description of the flattened form the influence of two additional forces, which, upon occasion, operate to still further modify the shape of the rachitic pelvis. These are lateral pressure of the heads of the thigh-bones at the acetabula and the various forms of spinal curvature which so commonly result from rickets.

Pressure at the acetabula is rarely an operative force, because rickets usually is developed at the time of the first dentition—i. e., before the child has learned to walk—and it is not until after the disease has declined that the child attempts to use its lower extremities. In the exceptional cases in which the disease occurs later, after the child has begun to walk, the lateral pressure may act in either one of two ways:

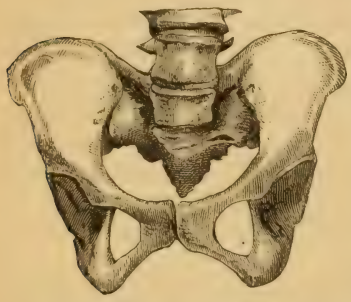


FIG. 207.—Small symmetrical rachitic pelvis. (Wood's Museum.)

1. As a counteracting force to that exercised by the weight of the trunk, in which case the pelvis, provided the pathological processes have only advanced to a limited extent, retains a symmetrical appearance, and resembles closely the justo-minor pelvis. The rachitic origin is betrayed by the shape of the ilia and the signs of rickets in other parts of the body. At the outlet the antero-posterior diameter is increased, and the transverse diameter somewhat diminished.*

2. In cases of excessive softening of the bones, either from the severity or the long duration of the disease, the acetabula are sometimes pushed inward, upward, and backward, and the symphysis pushed forward, so that the rami of the pubes meet at an acute angle, or run nearly parallel to one another. This lateral compression, in conjunction with the rachitic projection of the promontory, gives to the pelvic brim a triangular or clover-leaf shape, closely resembling the distortion produced in osteomalacia. The term pseudo-osteomalacia given by Michalis † to this form is warranted by the existence of certain features peculiar to rickets, such as the small size of the ilia, the distance between the anterior superior spinous

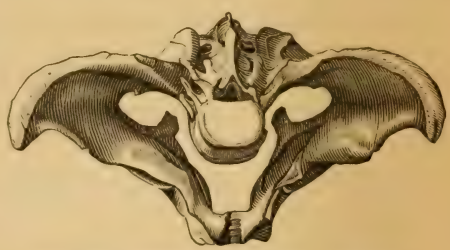


FIG. 208.—Pseudo-osteomalacia. (Naegele.)

* SCHROEDER, Schwangerschaft, Geburt. und Wochenbett, p. 77.

† MICHAELIS, Das enge Becken, p. 139.

processes, and the nature of the changes in other parts of the bony skeleton.*

In curvatures of the spine the shape of the pelvis is affected, when a compensatory scoliosis or kyphosis includes the sacral extremity:

1. In scoliosis (lateral curvature) all the rachitic features are usually strongly pronounced. The promontory is tilted to the side of the incurvation, and is pressed by the weight of the body toward the corresponding acetabulum. The ilium, owing to the increased pressure at the acetabulum from the femur of the affected side, is pushed upward, backward, and inward. In extreme cases the approximation of the promontory to the acetabulum may be such as to prevent the entrance of the child's head. The contracted portion becomes, therefore, unavailable for obstetrical purposes.†

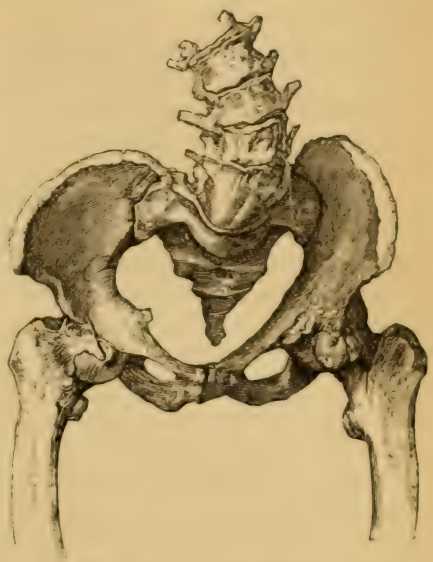


FIG. 209.—Scoliosis. (Litzmann.)

2. In kyphosis (posterior curvature) many of the characteristic features of the rachitic pelvis are reversed. As the upper portion of the sacrum is tilted backward, either the conjugata vera is increased or the previous rachitic antero-posterior narrowing is greatly diminished. In the movement of the sacrum upon its transverse axis the lower extremity is thrown forward, and the conjugate of the outlet is thereby reduced. Kyphosis, occurring at the beginning of rickets, diminishes the distance between the tuberosities of the ischia, but has little effect upon the inferior transverse diameter after the rachitic changes have once been accomplished.

INFLUENCE OF THE CONTRACTED PELVIS UPON PREGNANCY AND LABOR.

The influence of the contracted pelvis is not confined simply to the embarrassment which the form and size of the pelvis afford to the passage of the child in parturition; it extends to the production of a multitude of remoter effects, which are often regarded by the unin-

* The supervention of true osteomalacia upon rickets has been observed. (*Vide* SPIEGELBERG, Lehrbuch der Geburtshülfe, p. 490.)

† LITZMANN, Die Formen des Beckens, p. 70.

formed as isolated phenomena. These effects, which include faulty positions and presentations of the fœtus, unfavorable shape or position of the uterus, abnormal character of the pains, and the like, enter in turn, except where the mechanical difficulties are absolutely insurmountable, as important elements in the determination of the prognosis. For our knowledge of this subject we are indebted almost wholly to the enlightened labors of the Kiel professors Michaelis * and Litzmann.†

Influence of the Contracted Pelvis upon the Uterus during Pregnancy.—In the early months the only way in which the contracted pelvis exerts an influence is in sometimes favoring the dislocation of the uterus backward. This action is liable to take place when, in the second or third month, the uterus has been unusually depressed in the pelvis, and the fundus has swung backward toward the sacrum as the uterine axis approximates to that of the pelvic outlet. Under such circumstances the jutting of the rachitic promontory is calculated to mechanically interfere later with the ascent of the organ into the abdominal cavity, in which case the pressure of the inflated intestines upon the anterior aspect of the uterus pushes the fundus over the inclined surface of the sacrum, and *retroversion* is produced. As the gravid uterus enlarges, owing to the limited space within the pelvis the version gradual passes into a flexion, which, unless relieved, is followed by symptoms of incarceration.

In the latter months of gestation the uterus, as a rule, is lifted to a greater extent above the pelvis than occurs under normal conditions. This elevation is due to the growth of the child, which is prevented from sinking into the pelvis by the contracted conjugate. Sometimes the upward tendency of the uterus is overcome apparently by the resistance of the round ligaments, so that, while the head is retained at the brim, the lower segment hangs empty in the pelvis. At the same time the uterus possesses an unusual degree of mobility, in part due to the lack of fixation afforded by the descent of the fœtus into the pelvis, and in part to the laxity of the abdominal walls and the round ligaments. These latter conditions belong, of course, rather to multiparæ than to women for the first time pregnant.

In close connection with these two events, viz., the elevation of the uterus and its mobility, it is not uncommon to observe the higher degrees of the so-called pendulous abdomen, caused by the anteflexion of the gravid uterus. To this deformity, furthermore, the small stature of rachitic patients, the increased inclination of the pelvis, the anterior projection of the lumbar portion of the spine, and the stretched state of the abdominal walls, associated often with separation of the recti muscles at the linea alba, all contribute their part.

* Michaelis, Das enge Becken, Leipsic.

† Litzmann, Volkmann's Samml. klin. Vortr.," No. 23.

Influence of the Contracted Pelvis upon the Presentation of the Fœtus.—Faulty presentations occur in contracted pelves more than three times as frequently as in those of normal dimensions.* Thus, when, during the latter part of pregnancy, the narrow conjugate mechanically prevents the head from sinking into the pelvic cavity, the head frequently glides sidewise or forward, to rest upon an iliac fossa, or upon the upper border of the symphysis pubis. In pendulous abdomen the uterus, in place of being inclined, when the patient is in an upright position, at an angle of thirty-five degrees, becomes nearly horizontal, or may fall forward so that the fundus occupies a deeper position than the inferior segment of the uterus. The great mobility of the uterus admits likewise of extensive lateral movements. These combined causes account for the lack of stability in the fœtus and the comparative frequency with which shoulder and breech presentations occur. When the head is fixed at the brim, the conversion of the vertex into a brow or face presentation is often simply an exaggeration of the normal mechanism of labor in a flattened pelvis. If the head, in place of filling the lower segment of the uterus, is retained at the brim, the space left between the head and the uterine walls favors prolapse of the cord and extremities. In like manner, in breech presentations, when the breech is detained by the narrow conjugate, the feet are apt to descend first into the vagina.

Owing to the progressive relaxation of the abdominal and uterine walls with successive pregnancies, the frequency of these irregularities increases nearly in proportion to the number of previous births.

Influence of the Contracted Pelvis upon the Labor-Pains.—When the degree of pelvic contraction permits the delivery of the fœtus by the normal passages without resort to embryotomy, the favorable or unfavorable ending of the labor is in large measure dependent upon the character of the pains. Good pains are of vastly more consequence in narrow than in wide pelves.

Violent pains, where the mechanical obstacles are insurmountable, either from the smallness of the pelvis, the faulty presentation of the fœtus, the position of the child's head, or its size and hardness, endanger the integrity of the uterus. Indeed, unless the mechanical difficulties are diminished by rectification of faulty positions and presentations, or by embryotomy, or unless relief is afforded by the removal of the child by Cæsarean section, there is reason to dread in such cases the occurrence of ruptured uterus, or, after retraction of the cervix, that the uterus may be torn from the vagina.

Still more frequently weak pains are the cause of unfavorable terminations. Weak pains lead to lingering labors. Even in moderate

* Spiegelberg found that, of 544 labors in narrow pelves, the head presentation occurred in eighty-three per cent, whereas the proportion is ninety-five per cent in normal pelves. (Lehrbuch der Geburtshülfe, p. 448.)

degrees of contraction they fail to rectify unfavorable positions of the head or to force the head by the brim into the pelvis. Under such circumstances neither the forceps nor version can be employed without serious risk, while, if a waiting policy is pursued, the amniotic fluid gradually escapes, and, as the uterus retracts down closely upon its contents, the fœtus perishes from the gradually increasing hindrances to the uterine and placental circulation.

In prolonged labors good pains alternate at intervals with those of less force. There is no standard by which the quality of pains *per se* can be determined. The quality of the pains is to be estimated rather by the results which they accomplish. It may be stated as a general rule, to which, however, there are numerous exceptions, that the strength of the pains is proportioned to the strength of the resistance to be overcome. Strong pains are on the whole rather more common in flattened pelves, and weak ones in pelves contracted in all their diameters, without, however, the rule possessing any such constancy as to lead one to regard the form of the pelvis as alone possessing any decisive importance in the production of the result.*

In the first instance, the character of labor-pains depends upon the innervation of the uterus and upon the thickness and integrity of its muscular structures. The resistance which the narrow pelvis offers to the expulsion of the child increases necessarily during the pains the tension and irritation of the uterine walls; and these, corresponding to the degree of irritability and contractility of the organ, may provoke pains of unusual violence, which, in turn, terminate, when the resistance is not seasonably overcome, in exhaustion; or the uterine activity may cease without any previous stage of increment; or, finally, the tension and injurious pressure of the uterus may lead to local circulatory disturbances, and to textural changes which in themselves weaken the strength of the contractions.

Michaelis observed that the dangers to the mother and child grow, as a general rule—to which, however, there are numerous exceptions—in proportion to the number of confinements. The increased mortality, especially of the children, he attributed to a peculiar relaxation of the uterus and its pelvic attachments, due to overexertion in previous confinements.† But it must be borne in mind that there are other results of contracted pelves which directly contribute to the fatality of multiparous labors. Thus, we have seen that pendulous abdomen and mobility of the uterus favor abnormal positions and presentations of

* Michaelis thought that the partial pressure of the promontory and symphysis excited increased reflex action of the uterus in flattened pelves, whereas the complete pressure of the head upon the brim in generally contracted pelves exercised a paralyzing influence (*loc. cit.*, p. 185). This theory has been called in question by both Spiegelberg (*loc. cit.*, p. 452) and Litzmann. (Volkmann's Samml. klin. Vortr., No. 23, p. 177.)

† Michaelis, *loc. cit.*, p. 152.

the fœtus, complications of the utmost prognostic importance; and, again, that the displacements of the gravid uterus occur with special frequency when the abdominal parietes have lost their supporting power from the overdistention of previous pregnancies. Moreover, when the uterus is not fixed during labor, the expulsive action of the abdominal walls can not be called into play, and thus one of the most important auxiliary forces is lost. Further sources of danger lie in the increased size and hardness of the fetal head observed in later pregnancies, and in the residue of inflammatory troubles which so often proceed from the first difficult delivery.*

Influence of the Contracted Pelvis upon the First Stage of Labor.—At the beginning of labor the head in contracted pelves is usually retained above the os internum, while the lower segment of the uterus hangs empty in the pelvic cavity. As, under these circumstances, space is left between the head and the uterine walls, the entire column of amniotic fluid acts directly during the pains upon the cervix uteri. The dilatation of the cervix takes place gradually, from above downward, as expansion follows upon the descent of the amniotic sac. The shape of the bag of waters depends upon the greater or less degree of resistance offered by the cervical walls. If the latter are soft and distensible, the usual semi-globular contour is maintained. If the cervix offers any material resistance, the membranes, if sufficiently elastic, protrude through the external os in cylindrical form. If, finally, the chief opposing force to dilatation is situated at the os internum, a constriction may take place at that point, while below the membranes assume a spheroid shape. As the result of these conditions an unimpeded, wave-like movement of the amniotic fluid breaks against the protruding membranes during the pains, the shock of which is apt to produce premature rupture, an event which is all the more inopportune, because in early rupture the circumstances all favor the complete discharge of the amniotic fluid.

After the rupture of the membranes, as the head does not descend at once into the cervical portion, the os and cervix reclose, though they continue dilatable in proportion to the degree of distention previously accomplished. Then, as under the influence of the pains the head passes into the pelvis, it gradually once more unfolds the cervical canal, and completes its dilatation. Should, however, the head meet with any considerable resistance, so that the pressure of the pelvic brim gives rise to the formation of a scalp-tumor, the latter serves to dilate the cervical canal and the os externum. If the obstacle is such as to prevent the complete descent of the head, two results are possible:

1. If the pains continue strong and no measures are adopted to remove the disproportion, the uterus is either retracted up over the

* Spiegelberg, Lehrbuch der Geburtshülfe, p. 453.

head of the child as it remains above the brim, until the overdistended vagina gives way, in which case the laceration occurs in a transverse or oblique direction, and usually upon the posterior wall; or the lower segment of the uterus becomes compressed between the child's head and the walls of the pelvis, and a thinning and bruising of the imprisoned portion take place. As the uterus contracts, its muscular fibers drag upon the compressed and weakened tissues at the fixed points, which yield finally to the tractile force, and rupture ensues.

2. If the pains are weak or fail outright, the lower segment of the uterus remains undilated until either strong pains are excited or the mechanical hindrance is so far removed by perforation of the head that the weakened pains suffice to overcome the obstacle.

Influence of the Contracted Pelvis upon the Mechanism of Labor.—When the pelvic contraction is not such as to render the entrance of the head impossible, the mechanism of labor depends not only upon the size and shape of the pelvic space, but upon the size, form, compressibility, and position of the child's head. If a small, soft head has to pass through a pelvis contracted to only a moderate degree, the mechanism may not differ from that of a normal labor. In cases of relatively great disproportion, delivery is only practicable where the position of the head is favorable—i. e., corresponds in each case to the peculiar shape of the pelvis. If the conditions are favorable, and the pains are of normal strength, a segment of the head, after the period of dilatation has been completed, is pressed into the pelvis. The size of the segment depends upon the extent of the resistance offered, and thus, at an early stage, it furnishes us a notion as to the degree of disproportion existing. As labor progresses, the cranial bones change in shape and overlap one another, so that the head gradually becomes molded to the contour of the pelvic ring. When the largest circumference of the child's head has become fixed at the pelvic strait, as the contraction exists for the most part at the brim, the difficulties are usually overcome; and, where the pains continue good, the remainder of the labor is accomplished in accordance with the ordinary mechanism. If the pains fail, or the contraction continues throughout the entire pelvic canal, artificial aid may be needed even after the brim has been passed.

In the simple flattened pelvis the occipito-frontal diameter of the head engages in the transverse diameter of the brim. Even when the position is originally oblique, the intermittent contractions of the uterus communicate movements to the smooth surface of the head, which gradually bring its long diameter into correspondence with the long diameter of the flattened pelvis. The head enters the brim with its posterior surface tilted toward the shoulder, the anterior parietal bone presenting, and the sagittal suture running parallel with, and in more or less close proximity to, the promontory. This lateral obliqui-

ty, or obliquity of Naegele as it is termed, is due simply to the fact that the narrowing of the antero-posterior diameter prevents both parietal bones from entering the pelvis upon the same plane. When the broad region between the parietal bosses meets with the resistance of the conjugate, the occipital portion of the head glides to one side, and the narrow bitemporal diameter engages in the contracted space. In this position the occiput usually rests upon the *linea terminalis*. Owing to the resistance offered to the occiput, the forehead sinks into the pelvis, so that the large fontanelle occupies a deeper position than the posterior one.

Before the head adapts itself, therefore, to the pelvic entrance, the anterior parietal surface rests upon the symphysis, while the posterior surface is impinged upon by the promontory near the large fontanelle. The latter is felt low down, near the median line. The small fontanelle, owing to the dip of the forehead, is occasionally out of reach. Upon the side of the pelvis to which the forehead is turned, the space is incompletely filled out.

The adaptation of the head to the pelvic brim is the result of two combined movements, which occur nearly simultaneously :

1. The symphysis pubis furnishes a pivot around which the head rotates in the direction of the fronto-occipital diameter. As the head is pressed into the pelvis from above, the posterior parietal bone is flattened by the projecting promontory. During the descent the distance between the sagittal suture and the promontory gradually widens, and the former approaches the median line.

2. We have seen that the head entered the pelvis at first with a deep position of the anterior fontanelle. By the time, however, the bitemporal diameter becomes fairly fixed in the conjugate, the anterior fontanelle moves upward and forward toward the side wall of the pelvis, while the small fontanelle sinks downward, and occupies a position near the center of the cavity. This movement is not simply a crowding of the entire head in the direction of the brow, but is due to a rotation of the head upon an axis furnished by the conjugate diameter,* the symphysis and the promontory furnishing the pivotal points.

By the time, in the rotation of the head upon its fronto-occipital diameter, the posterior boss reaches the level of the promontory, the largest circumference of the child's head has already engaged in the straitened brim, and the influence of the pelvic flattening upon the mechanism of labor ceases. Then, if the pains continue good, the flexed head reaches the floor of the pelvis, the occiput rotates to the front, and delivery is accomplished as under normal conditions.

In the justo-minor pelvis, the mechanism of labor is nearly the reverse of that described in the flattened form. Thus, as a rule, both parietal bones engage in the pelvic brim at the same time—i. e.,

* Litzmann, Volkmann's Samml. klin. Vortr., No. 74, p. 557.

the obliquity of Naegele is either slightly marked or absent altogether. Again, the head may enter the pelvis in any of its diameters. To be sure, the oblique diameter is the one it usually occupies. Still, Litzmann reports two cases in which the sagittal suture corresponded to the conjugate diameter from the outset of the labor.* In the early stages, it is not uncommon for the head to oscillate at the brim for a time before fixation takes place.

Characteristic of transverse narrowing is the flexed condition of the head from the moment it begins its descent into the pelvis. Indeed, the flexion at the brim equals in degree that which usually obtains only at the pelvic outlet. The small fontanelle occupies the middle point of the pelvic space, the neck rests upon the linea terminalis, the anterior portion of the head and brow are pressed against the opposite pelvic walls, the long diameter of the head (from chin to vertex) lies in the axis of the pelvis, and the face looks upward toward the fundus uteri. If the transverse narrowing continues toward the outlet, the extreme flexion is maintained after the brow has passed below the level of the promontory. In such cases it may even happen that the small fontanelle may make its appearance at the frenulum in place of turning under the arch of the pubes. Sometimes the head gets fairly impacted in the pelvis, and further advance is rendered impossible. When the pelvis widens below the brim, the small fontanelle noticeably leaves little by little its central position.

In the generally contracted, flattened pelvis, the mechanism of labor is influenced by both the antero-posterior and transverse shortening. As in flattened pelves, the head usually occupies the transverse diameter, and the sagittal suture looks backward toward the promontory. Before the head becomes fixed, it often balances at the conjugate, rocking to and fro, as the uterus falls from the one side to the other. For a time, therefore, the position of the fontanelles varies with that of the woman. If, however, the disproportion is not absolute, and the pains suffice finally to fix the head, the latter usually becomes strongly flexed, and the occiput descends first into the pelvis.

When the head does not enter the contracted pelvis in an advantageous position, and the fault is not rectified either by the hand or the action of the labor-pains, delivery of the child without perforation often becomes impossible. The most dangerous of these faulty positions are:

1. Cases in which the lateral obliquity of Naegele is exaggerated, so that the presenting part is formed by the anterior parietal bone. The more striking forms usually occur in pelves with an extremely narrow conjugate and a high promontory. The former maintains the head high above the brim, while the latter imparts to the uterus a posterior concavity. As the uterine curve is followed by the axis of

* Litzmann, Volkmann's Samml. klin. Vortr., No. 74, p. 545.

the fœtus, the head is strongly bent toward the posterior shoulder. Sometimes in presentations of the anterior parietal bone the sagittal suture lies above the promontory, and an ear can be left just behind the sympyhsis.

2. Cases in which the pelvic brim is covered by the posterior parietal bone. The sagittal suture is then directed to the front, sometimes lying even above the superior border of the anterior pelvic wall. Near the promontory the squamous suture, and at times the ear, can be felt. This peculiarity is rare in other forms of contracted pelves, but occurs as often as once in five times (Litzmann) in flattened pelves with coincident shortening of the transverse diameter.

3. In cases of well-marked kidney-shaped pelves, the head may engage in one side of the pelvis only. The occiput then enters usually the side of the brim to which the back of the child is turned.

4. Brow and face presentations are simply exaggerations of the anterior dip of the head, which we have seen is the normal mode of descent during the early stage of labor in flattened pelves. Although not peculiar to contracted pelves, they should always, when present, lead to careful measurements of the pelvic diameters. They increase the difficulties of delivery, not only because of the unfavorable relations of the diameters of the head to those of the pelvis, but because the pelvic deformity interferes with the proper rotation of the chin and forehead forward under the arch of the pubes.

In breech presentations, the delivery of the trunk takes place in accordance with the ordinary mechanism in the normal pelvis. The arms, however, are more liable to be reflected to the sides of the head.

In flattened pelves the after-coming head enters the brim in the transverse diameter. The position of the chin, where the transverse space is ample, varies with the degree of conjugate shortening. Where the latter is only of moderate extent, the ordinary flexion of the head may not be interfered with. If, however, the disproportion between the head and pelvic diameters is considerable, partial extension takes place. In cases of extreme contraction the entire head may be retained at the brim. The chin is then usually turned forward so as to rest upon one of the pubic rami, while chin and occiput occupy nearly the same level.

In breech deliveries, the mechanism of the head's passage through simple flattened pelves varies as the head engages in a state of flexion or extension. In the former case, while the anterior parietal bone moves downward over the symphysis, the transit-line marked by the promontory upon the posterior parietal bone runs from its anterior inferior angle, just in front of the ear, in an oblique direction upward toward the parietal boss. When, however, the head enters the pelvis in a state of partial extension, a furrow is formed by the promontory, which runs nearly parallel to the coronal suture. If, finally, the ex-

tension is complete, and the occiput descends first into the pelvis, the marking of the promontory is found between the boss and the lambdoidal suture.

In pelves contracted in the transverse diameter, extension of the chin, unless the contraction be slight, proves an insuperable obstacle to delivery. Flexion, however, is the rule, as the resistance which the occiput meets with from the walls of the pelvis tends to direct the chin toward the chest.

The Effects produced in Contracted Pelvis by the Pressure of the Child upon the Soft Maternal Tissues.—The body of the child rarely, and only in cases of extreme prolongation of the expulsive period, leaves any traces upon the maternal soft parts. Injurious pressure proceeds almost exclusively from the child's head. As the intrapelvic organs sustain excessive pressure when of short continuance more easily than that which is moderate but prolonged, the most striking lesions are produced in head presentations. The after-coming head usually passes through the pelvis too rapidly to produce any pronounced effects. The pressure is, as a rule, most marked at the brim, where, as we have seen, the contraction is in the generality of cases greatest, and where the pelvic canal is most encroached upon by sharp projections. The pressure may be either diffused over the entire periphery of the brim, or it may be more localized at certain definite points.

Diffused pressure occurs in justo-minor pelves, or where complete accommodation of the child's head to the form of the pelvis takes place. It gives rise to disturbed circulation in the hypogastric veins, and as a further consequence to transudation of serum, and capillary hæmorrhages in the tissues of the cervix, the vaginal walls, and external organs of generation.

Circumscribed pressure leads to crushing, thinning, and at times to the complete destruction of the tissues acted upon, the extent of the lesion depending upon the intensity and duration of the force exerted. Usually the destructive action proceeds, following the direction of the pressure from within outward—i. e., the injuries are more considerable, both in degree and extent, in the tissues next to the child's head than in the deeper ones contiguous to the pelvic border. Complete perforation of the tissues during labor is rare. Perforation is commonly the result of necrosis, the sloughing of the compressed tissues taking place during the puerperal period.

The pressure from the promontory is brought to bear, with rare exceptions, upon the cervix uteri.* The supravaginal portion is more

* Litzmann, Volkmann's Samml. klin. Vortr., No. 23, p. 186. An exceptional instance of pressure ending in perforation of the posterior vaginal wall has been reported by Hofmeier (Zur Casuistik des Stachelbeckens, Ztschr. für Geburtsh. und Gynaek., vol. x, pp. 5, 6).

commonly affected than the vaginal portion. The consequent loss of substance is of a funnel shape, starting from the inner surface, and rarely penetrating through the peritonæum. The coverings of the promontory are not affected by pressure.

Pressure from the upper border of the symphysis pubis usually affects the vaginal wall and the adjacent tissues of the bladder. Fistulæ resulting are therefore much more commonly vesico-vaginal than utero-vesical. Here, too, the lesions are more extensive upon the inner surface of the utero-vaginal canal, and diminish as they extend outward. Thus, the destruction of tissue is greatest upon the cervical and vaginal walls, is less marked upon the posterior bladder wall, while the anterior wall exhibits only faint traces of injury.

Pressure from the lateral walls, and from the horizontal rami of the pubes, occurs most frequently in faulty positions of the child's head. Thus, in brow presentations, the intervening tissues are apt to become clamped between the occiput and the margin of the side wall. Again, when the sagittal suture is directed to the front, and the posterior parietal bone presents, a similar compression may take place between the anterior wall and the child's head. Sharp bony projections from the crests of the pubes are commonly covered by the tendinous attachments of the psoas minor muscles. In case of long-continued labor, however, the spinous outgrowths and sharp edges of the crests are liable to rub through their protective coverings, and secondarily the utero-vaginal tissues.

Influence of the Pressure of the Pelvis upon the Integuments of the Child's Head.—One of the commonest results of the peripheral pressure of the brim upon the child's head is the production of the scalp-tumor. Its formation is usually associated with compression of the cranial bones. As the bones overlap, the integuments of the engaged portion of the head are thrown into folds. As, however, in consequence of the obstruction in the venous circulation, transudation of serum takes place into the subcutaneous cellular tissue, the folds subsequently disappear, and a swelling ensues. It will be seen that conditions favorable to the production of the scalp-tumor are a soft, easily molded head, and such degree of transverse pelvic contraction as serves to render the circular pressure of the scalp complete. Owing to the latter condition, the scalp-tumor is found more frequently and more developed in justo-minor and generally contracted flattened pelves than in simple flattened pelves with normal transverse dimensions. Usually the tumor does not form until after rupture of the membranes. At times, however, in justo-minor pelves the head may become so fixed at the brim during the first stage of labor that a diffused swelling of the scalp may follow while the membranes are still intact. A scalp-tumor at the brim is of favorable import. It shows that the pains are good. So long as the tumor continues to increase, if the presentation

is favorable, the accommodation of the head remains a possibility. The increase of the tumor serves, too, to fix the head at the brim, and favors the overlapping of the cranial bones. It likewise gives to the head the form of an elongated ellipse, a form most favorable to its passage through the contracted pelvic canal.

Localized pressure-marks upon the child's head are derived, in the great majority of cases, from contact with the promontory. With less frequency they have their origin in pressure produced by the anterior and lateral pelvic walls and the inward projection, in rachitic pelves, of the cartilage at the symphysis pubis. They consist of round and oval spots and reddened lines, which disappear in the lighter cases usually in from twelve to twenty-four hours. If the pressure has been long continued, it may give rise to ulceration, or even to complete destruction of the skin down to the periosteum. While not usually dangerous to the child, in exceptional cases they may become the starting-point of suppuration in the surrounding subcutaneous cellular tissue, and thus lead to fatal pyæmia. They are found with greatest frequency upon the parietal bones, especially upon the posterior one. More rarely they are situated upon the frontal, and in very rare instances, finally, upon the occipital and temporal bones. The situation and direction of the red lines depend chiefly upon the manner in which the head enters the pelvis. Thus, in simple flattened pelves, where moderate extension occurs in the normal mechanism of labor, the mark of the promontory runs along the posterior parietal bone, between the boss and the large fontanelle, either parallel to the coronal suture, or at first in the direction of the boss, and then later as flexion occurs forward toward the frontal bone (Dohrn). In cases where transverse shortening causes flexion of the head at the brim, the principal point of pressure lies near the parietal boss, and the line runs obliquely forward toward the outer angle of the eye, or toward the cheek, according to the extent of the flexion. Sometimes a red line running across the forehead, nearly parallel to the coronal suture, is produced by the pressure of the side wall.

Fig. 210.—Pressure-mark upon skull. (Dohrn.)

Pressure upon the ophthalmic vein, when it occurs, leads to œdematous swelling and hyperæmia of the lid, and to increased secretion from the conjunctiva.

Influence of the Pressure of the Pelvis upon the Cranial Bones.—The so-called molding of the child's head, by which it is made to conform to the size and shape of the pelvis, is chiefly effected by the displacements and alterations in the form of the cranial bones. Of the

displacements, the most important consists in the overriding of the bones at the principal sutures. The most common site is along the sagittal suture. Usually the posterior parietal bone is flattened and depressed beneath its fellow. At the same time the curvature of the anterior or presenting parietal bone is increased. In transverse narrowing, the occipital bone is depressed along the lambdoidal suture. The position of the frontal bones at the coronal suture is subject to a variety of influences. As a rule, however, they are depressed beneath the parietal bones. Overlapping often does not extend the entire length of a suture, but may exist in one part, while in another the bones may occupy the same level. Sometimes a displacement takes place between the two lateral halves of the head in the direction of the occipito-frontal diameter. This movement is supposed to be due to the influence of the promontory, which pushes the posterior half forward when the head is flexed, and backward in cases of partial extension.

The compression to which the child's head is subjected, when prolonged and excessive, is apt to produce disturbed cranial circulation. Rupture of the capillaries which pass from the surface of the brain to the arachnoid sac, and to the sinuses of the dura mater, may give rise to intracranial extravasations. The overriding at the sagittal suture, in extreme cases, may cause laceration of the sinus longitudinalis. Separation of the bones at the sagittal and coronal sutures sometimes takes place while the coverings of the skull remain intact.*

In a small percentage of cases (7·3 per cent, Litzmann) furrow-like depressions occur. The usual site is along the line of the coronal suture, where they are formed by the promontory. In front a grooved line is sometimes found near the squamous suture, produced by the pressure of the anterior pelvic wall. Triangular depressions (the spoon-shaped depressions of Michaelis) situated upon the posterior parietal bone, between the boss and the large fontanelle, are of still rarer occurrence. They are found chiefly upon the heads of premature children, where they are of sinister import. Actual fracture of the skull in head presentations is extremely infrequent, and is generally due to the employment of the forceps.

In breech presentations, lesions of the scalp, owing to the shortness of the time to which the after-coming head is subject to the pressure of the contracted pelvis, are, in two thirds of the cases, absent altogether. When they are present they are comparatively trivial, consisting of slight swelling of the integuments, and now and then of a red mark left by the promontory. The cranial bones, on the contrary, when rapidly dragged by the projecting promontory, are peculiarly liable to serious injury. Thus, in breech cases, depressions, fractures, and fissures of the parietal bones are much more common than

* Litzmann, Volkmann's Samml. klin. Vortr., No. 23, p. 191.

in head presentations. Forcible tractions upon the trunk sometimes lead too to a rupture of the squamous sutures, or even to separation of the condyles from the occipital bones.*

Prognosis in Contracted Pelves.—The mortality to the mother is at least twice as great as in normal pelves. The causes of this increased death-rate are to be found in the concurrent action of a great variety of influences. Among the chief of these is the prolonged labor, an event which under all circumstances, especially after the rupture of the membranes, tends to diminish the chances of recovery. This result is due to the strain upon the nervous system from the protracted duration of the associated pain, to the depression of the vital powers growing out of the fasting and loss of sleep which labor entails, to the irritation and crushing of the soft parts, and, finally, to decomposition of the fluids retained within the uterine cavity in cases where access of air has taken place. In contracted pelves we have superadded to these general sources of disturbance the special injurious effects produced by the pressure of the lower segment of the uterus, the vagina, and the soft parts which cover the cavity of the small pelvis between the hard head of the child and the bony walls. As the results of pressure, we have seen that obstruction to the venous circulation, œdema, capillary hæmorrhages, superficial lacerations of the mucous membrane, and at localized points necrosis and even complete separation of the interposed tissue may take place. These further lead to metritis, endometritis, parametritis, and perimetritis, which are announced at times during labor, but more commonly subsequent to confinement, by sharp elevations of temperature. When the destruction of tissue reaches the peritonæum, general peritonitis follows, as a rule. When the necrosed tissues become gangrenous from access of air, the septic poisons generated spread through the cellular tissue, and lead speedily to a fatal termination. Sometimes shock destroys the patient during the first day or two following labor, before local inflammations have had time to develop. Further dangers to be apprehended are rupture of the uterus and the pelvic articulations, fistulous communications with the bladder and the rectum, injuries to nerves of the ischiatic plexus, *post-partum* hæmorrhage as a consequence of uterine exhaustion, and thrombus formation in the veins of the uterine parenchyma. Even the operative measures resorted to for the relief of the patients are often new sources of peril, and their employment is to be regarded simply as a lesser evil.

For the child the action of the contracted pelvis is even more deleterious.† The infant mortality, in cases not requiring sacrificial

* C. Ruge, Verletzung des Kindes durch Extraction bei Beckenlage, Ztschr. f. Geburtsh., Bd. i, p. 74.

† Spiegelberg puts the mortality of the children at thirty-five per cent (*vide* Lehrbuch der Geburtshülfe, p. 464).

operations, is explained by the long duration of the labor and the prevalence of faulty presentations and positions. In the majority of instances death takes place from asphyxia promoted by the early rupture of the membranes, the complete escape of the amniotic fluid, the prolapse of the cord, the disturbances in the utero-placental circulation resulting from the retraction of the uterus upon the surface of the child's body, and sometimes by the premature separation of the placenta. The prognosis for the child is especially unfavorable in premature labors. This arises not alone from the increased frequency of malpresentations, but from the diminished power of premature children to resist external pressure. Thus, death may take place from direct pressure upon the medulla oblongata through the thin bony coverings of the head, or extensive cerebo-spinal effusions of blood may result from the laceration of the delicate walls of the intracranial and intraspinal vessels.

CHAPTER XXVI.

TREATMENT OF CONTRACTED PELVES.

Cases of extreme pelvic contraction, rendering delivery *per vias naturales* impossible.—Cases indicating craniotomy or premature labor.—Cases where extraction of a living child at term is possible.—Premature labor.—Version.—Forceps.—Expectant treatment.

The resources at the disposition of the accoucheur, in cases of contracted pelvis requiring obstetrical aid, are the Cæsarean section, the induction of premature labor, craniotomy, forceps, and version. But, before it is possible to form an opinion regarding the treatment best suited to an individual case, it is necessary to first obtain a clear and definite idea regarding the degree and character of the pelvic deformity. We have, then, to settle the following questions: Has pregnancy advanced to term? If not, does the case call for the induction of abortion or premature labor? If the end of utero-gestation has been reached, is it possible to deliver the child through the natural passages? Is the child living or dead? If the former, do the interests of the mother require the sacrifice of the child's life? If the conditions are such as not to render it impossible for a living child to be born, in what way can we best subserve the interests of both mother and child? The right choice of measures requires not only an accurate appreciation of the advantages, limitations, and drawbacks which inhere to the measures themselves, but the extent to which the mechanical obstacles to delivery are heightened or modified by those remoter influences which we have seen are exerted upon the organic processes of labor by the pelvic contraction.

The greater the degree of pelvic narrowing, however, the more decided the influence of the pelvis becomes, and the more definite, therefore, the treatment.

For the sake of convenience it is customary to consider apart the following classes:*

1. *Cases of such extreme pelvic contraction that the attempt to deliver the child through the natural passages is inadvisable.* In these extreme degrees of pelvic deformity premature labor holds out no hope of saving the life of the child, and affords but a trifling advantage to the mother. If abortion is not produced in the early months, the only resource is the Cæsarean section or laparo-elytrotomy. The precise limit at which the dangers from delivery through the pelvis rise to the level of or exceed those from the Cæsarean section is not easy to determine. It depends partly upon the size and ossification of the child's head, and largely upon the experience and dexterity of the operator.

Michaelis, in the case of a dwarf scarcely three and a half feet high, extracted a small child through a pelvis measuring but one inch and a half in the conjugate diameter. The operation lasted two and a half hours. At the end of two weeks the patient was able to resume her household duties.† Dr. Osborn, in the celebrated case of Elizabeth Sherwood, extracted a child through a pelvis measuring, as he believed, but three quarters of an inch in its narrowest portion! Barnes‡ extracted with perfect success a child through a conjugate which, he says, certainly did not exceed one inch and a half. It would be easy to go on and extend this list, to show that there is no degree of conjugate shortening that renders it utterly impossible to extract a mutilated child. But the question which we should ask for our guidance is, not what can possibly be accomplished by the skill and ingenuity of the exceptionally experienced operator, who is capable of making whatever rules he likes to govern his own actions, but what is the point at which men in every-day practice need expect to find the dangers from craniotomy and the Cæsarean section rise to nearly the same level. Dr. Parry collected seventy cases of craniotomy in pelves measuring two and a half inches and under. Seven had to be terminated, finally, by Cæsarean section. Of the seventy women forty-three survived and twenty-seven died. The work was not done by tyros, but by celebrated obstetric surgeons. Thus, the best results of the ablest accoucheurs before the days of antisepsis showed a mortality from craniotomy, in the higher degrees of pelvic deformity, of nearly forty per cent. Unquestionably this heavy death-rate has been lowered by modern aseptic

* The limits are those of Litzmann. *Vide* Ueber die Behandlung der engen Becken, Volkmann's Samml. klin. Vortr., No. 90.

† Michaelis, Abhandlungen aus dem Gebiete der Geburtshülfe, p. 151. The operation lasted two and a half hours.

‡ Barnes, Obstetric Operations, p. 406.

methods; still, in the hands of an operator of limited experience, I believe the Cæsarean section, when timely made, offers ordinarily to the mother a better chance of recovery. There are, of course, exceptions to the rule. Most pelves measuring less than two and a half inches in the conjugate belong to the category of generally contracted flattened pelves. Where, exceptionally, the transverse diameter is not materially diminished, the difficulties of craniotomy are greatly lessened, and, if at the same time the child's head be soft and compressible, a comparatively easy extraction may give rise to false ideas concerning the real dangers of delivery by the natural passages. These are due chiefly to the fact that the operation has to be carried on within the uterine cavity, when, owing to the contracted brim, no descent of the head is possible. A long operation conducted within the uterine cavity is always fraught with evil.

The dangers are not altogether mechanical. Even if serious lesions, such as perforations, rupture of the uterus, and lacerated wounds, are avoided, some contusion of the lower uterine segment is inevitable, air enters freely the uterine cavity, the patient exhibits very commonly the symptoms of profound shock, and the delivery is often followed by *post-partum* hæmorrhage, due to uterine inertia. The means employed to check hæmorrhage tend still further to depress the vital powers. In many cases the uterus remains large and the labor is followed by catarrhal endometritis. This ordinarily mild puerperal affection is apt, owing to the introduction of air and the presence of bits of necrosed tissue, to assume a septic form, and pave the way to a fatal termination.

The contiguity of the peritonæum likewise adds to the formidable character of all suprapelvic operations. When the outlet of the pelvis alone is contracted, and craniotomy can be performed upon the head after it has entered the vaginal canal, the dangers of extraction are much diminished; but even when recovery takes place, the unavoidable injuries inflicted often lead to life-long invalidism.

Cases of extreme degrees of the justo-minor pelvis are believed to be excessively rare. Certainly the whole number reported since Naegele's day may be easily counted on the fingers of the two hands. At full term the labor takes place, provided the general contraction is such as to retain the head at the brim, in one of two ways:

1. The uterus retracts up over the head of the child. If the head does not descend, the vagina is drawn upward and is exposed to injurious tension. Should nothing be done to relieve this condition, the thin vagina is liable to be rubbed through by the pressure it encounters at the brim, and especially at the symphysis pubis. Version would here be impossible, and the forceps would only enhance the risks. Perforation and decerebration would at once diminish the pressure. With little over three inches in the conjugate and four in the transverse diameter, the vault of the skull may be broken up with the cranioclast, the chin tilted downward, and the head brought edgewise through the pelvis. In this way, with moderate skill, it would be possible to extract a dead child.

The operation of laparo-elytrotomy, however, seems so peculiarly fitted to these conditions, that it deserves a trial in the interest of both mother and child.

2. The membranes rupture early, the waters gradually escape, and, as the head does not descend, the uterus retracts down firmly upon the child. A scalp-tumor forms, which fixes the head at the brim and pushes the cervix and lower segment of the uterus before it. Here it would be proper to await for a time the results of uterine action. As the transverse diameter can only be roughly estimated, the head may lengthen out and adapt itself to the pelvic canal. But the delay should not be too prolonged. If, in spite of the formation of the scalp-tumor, the bony head remains unmoved at the brim, it is a question whether it would not be the wiser plan to proceed at once to the Cæsarean section.

Naegele* reports the history of a dwarf whose pelvis measured but three inches and seven lines in the transverse and three inches in the conjugate. He delivered her with forceps of a five-and-a-half-pound child, but she died on the tenth day. Heim reports the history of a dwarf with three and a quarter inches conjugate and four and three quarters inches transverse diameter. Delivery by perforation and forceps. Rupture of the three articulations.†

Spiegelberg reports a case with nearly the same dimensions. Child presented by the breech. Extraction difficult. Perforation of after-coming head. Cephalotripsy. The patient died shortly after delivery.‡ I have reported a case where the conjugate was three and one sixth inches and the transverse four and a half inches. Delivery by perforation, the cranioclast, and the crotchet. The patient died on the third day (Trans. of the Am. Gynæc. Soc., vol. iv). Kormann relates a case nearly identical with my own, both as regards its diameters and the existence of a slight lateral obliquity. After over three days' labor the head adapted itself to the pelvis, and the child was extracted alive by forceps. The mother died of peritonitis.#

Thus, of five women with generally contracted pelves, in which the conjugate ranged from three to three and a quarter inches, all died as a consequence of delivery through the natural passages.

In cases where the uterus is rigidly applied to the child, and the cervix is undilated, the propriety of laparo-elytrotomy is questionable. The operation is not always a very easy one, and it certainly can not afford to be handicapped by anything which would cause delay in the delivery after the vaginal rent has been made.

There are, of course, in so rare a condition, scant statistics in favor of any special plan of treatment. Michaelis reports a case of Mantz's, that of a woman who had a pelvis measuring two inches antero-posteriorly and three inches in the transverse diameter. Here the Cæsarean section became a matter of necessity rather than one of election. Twice the operation was performed with success. A third time the result promised to be equally favorable, but the willful and insubordinate conduct of the patient, as late as the twenty-seventh day, led to her destruction.

In spite of the fact that in generally contracted pelves craniotomy is nearly

* Naegele, Das schräg verengte Becken, p. 102.

† Löhlein, *op cit.*, p. 42.

‡ Spiegelberg, Lehrbuch der Geburtshülfe, p. 444, *vide* note.

Kormann, Ueber ein allgemein verengtes, schräg verschobenes Becken, Arch. f. Gynaek., p. 472.

always practicable, a careful study of the ground convinces me that where there is a diminution of nearly an inch in all the diameters, Cæsarean section holds out the best chance for saving the mother's life.

2. *Cases in which the pelvic contraction is such as to prevent the birth of a full-term living child through the natural passages, but in which extraction through the pelvis furnishes the best chance of saving the life of the mother.* The choice of measures in this class of cases lies between the Cæsarean section, craniotomy, and, where the condition of things is recognized early enough, the induction of premature labor. In general terms we are authorized to assume such a degree of disproportion in flattened pelves with the conjugate ranging between two and a half and three inches, and in justo-minor pelves with a conjugate measuring three and a third inches. In, however, these less extreme degrees of deformity, other elements than those of the size of the pelvic canal enter into the formation of an opinion regarding the proper procedure to be selected. I have, myself, in one case, extracted a child weighing six and a half pounds by forceps, without much difficulty, through a generally contracted flattened pelvis with a conjugate measuring barely two and three fourths inches. Labor had lasted three days previous to my seeing the patient, which was in consultation. The child's head presented a singular appearance, from the molding it had undergone, having been greatly flattened in its biparietal diameter and enormously elongated in the occipito-mental direction. The child died, however, shortly after birth. The mother recovered, though considerable sloughing of the vaginal walls followed the long continuance of the pressure which had preceded delivery. Grenser, in the Dresden Hospital Reports (1861–'63), gives three cases of children born alive where the pelvis measured two and three quarters inches. In one of these, where the labor lasted twenty-two hours, a living child was born weighing six and a half pounds.

If, therefore, labor comes on at full term, an attempt should first be made to gauge the degree of disproportion between the head and the pelvic brim, for not only is it among the bare possibilities that a living child may be expelled through a pelvis measuring less than three inches, but it is to be borne in mind that in pelvic mensuration even the most expert may make errors of a quarter of an inch. In any case it is well to preserve the membranes as long as possible. Even craniotomy is more easily performed after complete dilatation of the os. After the waters escape, the lower uterine segment is subjected to injurious pressure between the hard skull and the pelvic rim, the damage done increasing of course with the duration of labor. By early perforation and evacuation of the brain-mass this danger is avoided. But craniotomy should not be performed so long as the hope exists of saving the life of the child. The attempt should be made, at least, before perforating, to form an estimate of the size of the child's

head and its relations to the pelvic brim. An approximative result may be obtained by palpating the head through the abdominal walls above the pubes, and, so soon as the cervix is dilated and the head becomes pressed by the labor-pains firmly against the brim, by introducing the half-hand into the vagina to determine the extent of that portion of the cranial vault which has entered the pelvis. When we have ascertained the size of the segment beneath the pelvic border, and the special points of the head which occupy the several pelvic diameters, we are in a position to estimate the size of the portion above the brim, and the mechanical difficulties which remain before the engagement of the head can be accomplished.

In shoulder presentations, where, of course, version is necessary, extraction alone should be first tried, and only when it is found impossible to effect the delivery of the after-coming head by other means should perforation be resorted to. Schroeder claims to have extracted living children through pelves measuring but seven and a half centimetres (three inches) in the conjugate.*

The induction of premature labor in pelves having from two and three quarters to three inches conjugate diameter possesses the merit of diminished risk to the mother, and affords a chance of saving the life of the child. Below two and three quarters inches the advantages of premature labor may be fairly called in question. To be sure, Kiwisch placed the biparietal diameter of the child's head in the thirtieth week at two and a half inches. Seyfert, however, fixed it at three inches, and later Schroeder obtained nearly three and a quarter inches (8·16 centimetres) as the average between the twenty-eighth and thirty-second week. In point of fact there is too little uniformity in the diameters of fetal heads belonging presumably to the same week of development to make average measurements of any practical utility. It will be seen, however, that, in the higher degrees of pelvic contraction we are now contemplating, the biparietal diameter of the child's head rarely falls within the limits of the narrowed conjugate. Still, it is possible to deliver a living child through a pelvis estimated at two and three quarters inches as late as the thirty-fourth week,† as the head, owing to the pliability of the cranial bones in premature children, is capable of sustaining a considerable degree of lateral compression. Naturally the infant mortality in these cases is very large. In addition to the ordinary increased risks attendant upon premature labor, intracranial extravasations of blood from rupture of the delicate cerebral vessels are extremely common. Litzmann found in nearly one fourth of his cases (8 : 34) spoon-shaped depressions of the skull. Though this lesion is met with upon the heads of living chil-

* Schroeder, Lehrbuch der Geburtshülfe, p. 539.

† Wiener, Zur Frage der künstlichen Frühgeburt, Arch. f. Gynaek, Bd. xiii, p. 99.

dren at full term, in the series of Litzmann four of the children were dead at birth, three showed feeble signs of vitality, and in one only, which lived but fourteen hours, was it possible to excite the respiratory process. Thus, the outlook for the child is by no means hopeful; but, inasmuch as, under three inches, the only operations which come into competition with premature labor are the Cæsarean section and craniotomy, a small saving of fetal life is a powerful plea in its justification. But a stronger argument in its favor is the fact that the induction of premature labor offers a milder procedure, which, within certain limits, inures to the benefit of the mother.

Below two and three fourths inches the chances of saving the child by premature labor are too slight to be weighed in the balance.* Moreover, unless the child's head happens to be exceptionally small and yielding, approximating the conditions to those which obtain in immature deliveries, craniotomy in the end has usually to be resorted to. Now, as premature labor offers no peculiar advantages in the performance of craniotomy, and, as it is attended with certain risks of its own, it is advisable, in very narrow pelves after the twenty-eighth week, to await the normal end of gestation.

As the dangers to both mother and child are increased by delay, Barnes has proposed combining version with premature labor in pelves of less than three inches conjugate, as a means of accelerating delivery. Milne by this method extracted a living child through a two and a half inch pelvis. Budin has found by experimentation with artificial pelves that a much less amount of traction force is requisite to drag the head of a premature child through a flattened conjugate by the feet than by forceps in cephalic presentations.

The time is probably not far distant when it will be possible to substitute the Cæsarean section for craniotomy within the limits of pelvic contraction under consideration. Craniotomy requires rigid antisepsis, a sufficient armamentarium, and an accurate knowledge of the parturient passage. With the adoption of modern methods in hospital practice, Olshausen reports a death-rate from craniotomy of 5·7 per cent; Credé, a death-rate of 8 per cent; and Gusserow reports from Berlin a death-rate of 14·3 per cent, or, excluding cases in which the death had nothing to do with the operation, the death percentage was reduced to 8·3 per cent. Leopold had 71 cases with two deaths; but the latter were from eclampsia, and were not the result of the operation.†

For the successful performance of the Cæsarean section there is needed training, adequate preparation, skilled assistants, and that the resistance of the patient

* In support of this opinion, which is thoroughly confirmed by my own experience, we have especially the authority of Spiegelberg, Litzmann, and Dohrn. Milne (Premature Labor and Version, Edinburgh Med. Jour., vol. xix, p. 707) relates a case where he was successful in a pelvis measuring but two and a half inches. He states, however, that the space in the other diameters of the brim was ample, which was certainly an exceptional advantage, as nearly all pelves with the higher grades of deformity belong to the category of generally contracted rachitic pelves.

† Praeger, Der Kaiserschnitt, etc., herausgegeben von Dr. G. Leopold.

shall not be too much weakened by protracted delay. Of 252 cases operated on according to the method of Sänger, between the years 1882–'89, inclusive, 63 (25 per cent) terminated fatally, but in 1890, of 61 cases, only 7 women died (11·4 per cent). The possibilities of the improved Cæsarean section is, however, best shown in the results obtained by single favored operators. Thus Leopold had had up to August, 1890, 42 cases with four deaths, and in Leipsic, of 36 cases, only 2 terminated fatally. Murdoch Cameron had 9 cases (simultaneous removal of the ovaries) with the loss of 1 patient. Sänger had 8 cases, Van der Meig 7 cases, and Schauta 15 cases without a death.*

3. *Cases in which the pelvic contraction does not exceed the limits within which the delivery of a living child at term is at least possible.* In this category belong the overwhelming majority of all instances of contracted pelvis. It embraces not only cases in which the conjunction of every favorable condition is essential to delivery, but those moderate degrees of narrowing which are chiefly recognizable through the influence they exert upon the mechanism of labor. It includes flattened pelves with a conjugate of three inches and upward, and justo-minor pelves with a conjugate of over three and a third inches. Below these figures the delivery of living children at full term is too exceptional an event to be taken into account in any attempt at classification.

The obstetrical resources for overcoming the mechanical obstacles afforded by moderate degrees of pelvic contraction are the induction of premature labor, craniotomy, forceps, and version. Each one of these measures has its strenuous partisans, who have expended much unprofitable zeal in comparative estimates of their respective values. It is a mistake to regard them as rival pretenders to favor. Indeed, the very conditions which indicate one form of procedure often exclude the others from consideration. Good midwifery requires a just appreciation of all the auxiliaries at our disposition and a careful study of the circumstances which render them severally appropriate.

Premature Labor.—The indiscriminate induction of premature labor in every case of contracted pelvis is particularly to be deprecated. In the first volume of the Archiv für Gynaekologie Spiegelberg presented the statistics of 1,224 cases of full-term labor in contracted pelvis, in which the maternal mortality was 6·6 per cent and the infant mortality 28 per cent; while in 271 cases of induced premature labor the maternal mortality was 18·8 per cent and the infant mortality 66 per cent. This startling discrepancy is due to the fact that a very large proportion of labors in contracted pelves either terminate spontaneously or require forceps only after uterine action has overcome the obstruction at the brim. If all these minor cases be omitted, a very different result is obtained. Thus, Litzmann found that in flat-

* Jahresbericht ueber die Fortschritte auf dem Gebiete der Geburtshülfe und Gynaek., III Jahrgang, s. 294, und IV Jahrgang, s. 316.

tened pelves measuring from two and three fourths to three and one fourth inches in the conjugate, and in justo-minor pelves between three and one third and three and a half inches, the maternal mortality after premature labor amounted to 7·4 per cent, while the loss of life in labors at full term was 18·7 per cent.* But, in cases of recovery, the advantages of premature delivery are by no means inconsiderable, as, owing to the diminished head-pressure, lesions of the genital canal are of rare occurrence, in striking contrast to the fistulæ, lacerations, and cicatrices which so often follow delivery at full term.

The prognosis for the child, as shown by the statistics of premature labor in contracted pelves, is decidedly unfavorable. In the restricted class of cases we are at present considering Litzmann found that, though twice as many children were born alive as at full term, the actual number discharged alive from the hospital was about the same. He concluded, therefore, that, while the operation was decidedly indicated in the interests of the mother, it offered a dubious advantage to the child. It is, however, always injudicious to draw deductions from hospital statistics alone. Especially is this true of feeble children, born prematurely, whose ultimate chances depend in a peculiar degree upon the care with which they are tended.

Dohrn, who objected to the statistics of Spiegelberg and Litzmann, on the ground that the units of which they were composed represented, not parallel cases, but an endless variety of dissimilar conditions, proposed, as a fairer way of testing the value of induced premature labor, to compare the results of the latter operation with those of full-term labors in the same patients. Viewed in this way, premature labor in contracted pelves has been found to furnish unexpectedly favorable results. Thus, Dohrn reports nineteen cases, with forty-one children at term, of which thirty-seven died. In twenty-five pregnancies premature labor was induced, with fifteen living children.† Künne and Berthold report eight cases, with twenty-four children at term, of which eighteen died. In eighteen pregnancies premature labor was induced, with thirteen living children.‡ Still more extraordinary is the report of Milne. Six women gave birth at term to twelve children, of which eleven were dead. In the succeeding thirty-eight pregnancies premature labor was induced, and thirty-five children were born living.#

The ordinary time for bringing on labor is from the thirty-second to the thirty-fourth week. Most writers now agree that the operation

* Litzmann, Ueber den Werth der künstlich eingeleiteten Frühgeburt bei Beckenenge, Arch. f. Gynaek., Bd. ii, p. 194.

† Dohrn, Ueber künstliche Frühgeburt bei engen Becken, Arch. f. Gynaek., Bd. xii, p. 70.

‡ Künne, Fünfzehn Fälle der künstlichen Frühgeburt; Berthold, Zur Statistik der künstlichen Frühgeburt, Arch. f. Gynaek., Bd. vi, Heft 2.

Milne, Premature Labor and Version, Edinburgh Med. Jour., vol. xix.

should be restricted to pelves measuring less than three and a half inches in the conjugate, whereas above that limit it is best to await the results of spontaneous uterine action.

Labor at End of Gestation.—But the physician may first be summoned to a case of contracted pelvis after the end of gestation has been reached, or he may at an earlier period have decided against the induction of premature labor.

At full term, supposing the head to present, the latter, at the beginning of labor, is prevented by the pelvic narrowing from entering the brim of the pelvis, and is usually freely movable. The conduct of the first stage of labor should be directed to preparing the way for the subsequent delivery of the child. To this end every pains should be taken to prevent rupture of the membranes until the cervical dilatation has become complete. The patient should be cautioned against restless movements in bed, and from bearing down during the pains. Examinations *per vaginam* should be made with great care, and should be avoided except where absolutely necessary. The largest-sized Barnes dilator, moderately distended with fluid, placed in the vagina to exert counter-pressure upon the cervix, is at times of use where the membranes have a tendency to protrude in the form of a narrow cylinder.

Attention should likewise be directed to faulty positions and presentations of the child's head. Should these be dependent upon a pendulous abdomen, the fundus of the uterus should be elevated, and the normal relations of the uterine axis maintained by a suitably adjusted bandage. Excessive lateral obliquity should be corrected by placing the patient upon the opposite side. Should transverse narrowing require a deep descent of the occiput, this can be furthered by placing the woman upon the side to which the occiput is directed. Where, on the other hand, it is desirable to promote the dip of the forehead, the patient should be made to lie upon the side to which the child's face is turned. The reason of this is obvious, as, when the breech falls to a given side, the cephalic pole has a tendency to move in the opposite direction. The right use of position as a corrective force depends upon the degree of accuracy with which the character of the pelvic deformity is estimated, and upon a proper appreciation of the mechanism appropriate to the ascertained deformity.

Where the sagittal suture looks forward toward the symphysis pubis, so that the posterior parietal bone becomes the presenting part, a firm compress above the pubes may be advantageously employed to press the head backward and approximate the sagittal suture to the median line.

The pains, when weak and inefficient, should be strengthened by the warm vaginal douche; when the source of exaggerated suffering, they should be mitigated by morphine, by rectal injections of chloral, or by the administration of an anæsthetic.

Should, by good fortune, the rupture of the membranes be postponed until after the completion of cervical dilatation, one of two contingencies may follow: 1. The disproportion between the head and the pelvis may prove to be slight, so that a considerable segment of the cranial vault may be felt below the brim; then, provided the head enters the pelvis in conformity with the mechanical laws dictated by the character of the pelvic deformity, the expulsion of the child may be left to the natural uterine forces. 2. No engagement may take place, the head continuing freely movable at the brim. Under such circumstances the disproportion may be assumed to be considerable. The physician has, therefore, to ask himself whether he shall await the action of the pains, in the expectation that the head will gradually adapt itself to the pelvis, or whether he shall at once proceed to perform version, and drag the child rapidly through the straitened diameters. The forceps, as a means of delivery before fixation of the head, should be discarded, not because it can not be employed with success, but because its use, even in the most skillful hands, is extra-hazardous.

The question of waiting, or proceeding at once to version, is one that will always be decided largely by the individual experiences of the accoucheur. It is, however, vain to deduce rules of practice from the conduct of those who have enjoyed exceptional opportunities, and who usually have developed exceptional skill in some one special direction. It is to be remembered that in contracted pelves, in case the pains prove inadequate to overcome the obstacles to delivery, the alternatives in head presentations are forceps and perforation. But there are very few experienced operators who have not a more or less personal predilection for either forceps or version, and this unconscious bias exercises, necessarily, to some extent, a determining influence upon their choice. It is well known that there is hardly any subject which has been the source of so much heated controversy as the one at present under discussion. For the profession at large, however, there is little to be gained from the spirit of partisanship. The general practitioner requires instruction not only in the special advantages possessed by each measure, but needs to have presented to his attention parallel statements of the dangers and difficulties from which neither procedure is free.

Version.—In considering the application of version to the treatment of contracted pelves, it is well to state in advance certain points which are rarely alluded to, probably because they are matters of tacit agreement between the contending parties to whose disputes we mainly owe our present knowledge in relation to the subject.

The first of these points is, that the intent of the operation is to save the life of the child. In the case, therefore, of a dead child, or of one in which the heart-sounds have notably begun to fail, version

affords no advantage over perforation. For the same reason the conditions must be such as to hold out a reasonable hope of rapid delivery of the child's head, without the infliction of necessarily fatal lesions. Now, there does not appear to be any well-authenticated case of the extraction of a full-term living child after version through a flattened pelvis measuring less than two and three quarters inches in the conjugate diameter. But even with three, or three and a quarter inches, the result will still depend upon the length of the transverse diameter. Thus, in extreme degrees of the justo-minor pelvis, with the reduction of nearly an inch in all the diameters, the difficulties of delivering the after-coming head, even with the aid of the perforator and the cephalotribe, are well-nigh insurmountable. Again, the contraction should be limited to the pelvic brim, for, where it is continuous, or progressively increases toward the outlet, the fate of the child is not even doubtful.

The other point of importance is, that with three and a half inches and upward in the conjugate, no interference is, as a rule, called for. Since it has become the custom to measure pelves with accuracy, the profession has learned that these moderate degrees of deformity exercise their influence not so much in a mechanical way as in the modifying effects they produce upon labor. A large proportion of the cases terminate spontaneously. If the pains fail prematurely, the conditions are generally such as to make it an easy matter to deliver with forceps. Difficulties only arise where the head is unusually large and incompressible, or in faulty positions, such as the anterior dip of the head in justo-minor pelves, and the presentation of the posterior parietal bone in the flattened varieties.

FIG. 211.—Base of skull. M M, bimastoid diameter.

Thus, version is indicated in contracted pelves only where the child's heart beats with nearly unimpaired vigor and in pelves measuring between two and three quarters and three and a half inches antero-posteriorly, with the contraction limited to the brim, and with sufficient amplitude in the transverse diameter.

The advantages of version in contracted pelves grow out of the unquestioned fact that the after-coming head passes more readily the contracted brim than the normal head-first presentation. This superior facility is attributable to the entry of the head by its smaller bimastoid diameter. At the same time, the fronto-occipital descends in the transverse diameter of the pelvis. The pressure of the conjugate is encountered by the bitemporal diameter of the child's head, which measures a half-inch less than the biparietal.

Tractions upon the trunk of the child bring to bear simultaneously pressure upon the head from many points in the pelvic walls. As a result, bilateral flattening is effected, and a deep groove, usually near the coronal suture, is produced in many cases upon the posterior cranial surface by the pressure of the projecting promontory. The bulk of the head is still further diminished by an overriding of the bones at the sagittal suture, and, where the transverse diameter is insufficient, by the crowding of the occipital beneath the parietal bones. A reduction of the cranial contents is brought about by the retreat of a considerable portion of the cerebro-spinal fluid into the spinal canal. All these changes are induced rapidly, and are not dependent upon the activity and strength of the uterine pains.

The method of performing version and extraction in contracted pelves is, with few modifications, the same as in pelves of normal size.

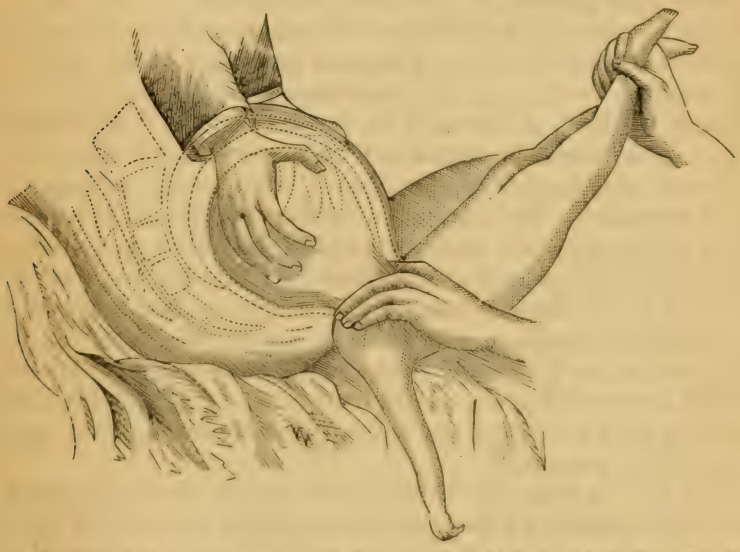


Fig. 212.—Method of employing suprapubic pressure. Head in the pelvic cavity. (Mundé.)

In contracted pelves great care requires to be taken lest the arms become reflected upward to the sides of the child's head, or crossed upon the neck. To avoid this difficulty it is desirable to introduce the hand over the abdomen of the child, and bring down the arms before the engagement of the shoulders. In extracting the head, tractions may be made upon the lower extremities and shoulders according to the method of Kiwisch, or they may be made with one hand upon the shoulders, while two fingers of the other are inserted into the child's mouth. Provided by either of these methods the relation of the head to the shoulders is such that no twisting of the neck takes place, the amount of force that can be employed without producing

fatal lesions is often something astounding. Thus, Rokitansky,* experimenting with the bodies of still-born infants, found the utmost strength put forth by two men upon the trunk was insufficient to cause rupture of the vertebral ligaments and separation of the articulations. It is usual, however, to combine pressure from above, exercised by a skilled assistant upon the head through the abdominal walls, with tractions from below. Schroeder states† that this practice is coeval with podalic version. It was known to Celsus and recommended by Ambroise Paré. It has found warm advocates in Pugh, Wigand, Martin, Kristeller, and in this country in Taylor and Goodell. Both the latter gentlemen have made valuable suggestions regarding the technical management of difficult cases, which are well worthy of special mention. Dr. Taylor‡ at first draws the body directly backward while the head is forced by suprapubic pressure downward and backward into the pelvis. So soon, however, as the head begins to advance, he raises the body of the child and directs pressure upon the head to be made downward and forward in the axis of the outlet. In case of failure or delay, he has sometimes succeeded by intentionally directing the back of the child to the sacrum, and then causing the occiput to be pressed downward and backward into the nearest sacro-iliac space, with the face looking upward, while traction is made in the axis of the outlet. Dr. Goodell,# after first drawing in the direction of the outlet, with the assistant pushing downward and backward, reverses the direction, and sweeps the child's body backward upon the coccyx, the neck likewise being forced downward and backward into the hollow of the sacrum with all one's power. Where the projection of the promontory is not very marked, he likewise recommends as sometimes of assistance a pump-handle movement, the range of oscillation extending from the axis of the outlet anteriorly to very firm pressure on the coccyx posteriorly.

It is obvious from the foregoing description that version and extraction in contracted pelves expose the child to perils of no insignificant character. Among the lesions which have been observed as a result of the extreme traction force necessary to bring the head rapidly through the narrow brim are fracture of the clavicles, fracture of the humerus in difficult arm-deliveries, lacerations of the sterno-cleido-mastoid muscles, rupture through the substance of a vertebra, extravasations of blood into the cavities of the head and trunk, separation of the condyles from the occiput, and of the squamous portion of the temporal from the parietal bones, fractures and depressions of the

* Rokitansky, Wien. med. Presse, 1874, No. 45.

† Schroeder, Handbuch, 6te Aufl., p. 307.

‡ Taylor, What is the Best Treatment in Contracted Pelves? p. 23.

Goodell, Clinical Memoirs on Turning in Contracted Pelves, Am. Jour. of Obstet., vol. viii, p. 211.

skull, and rupture of the sinuses of the dura mater.* To be sure, many of these accidents are not inevitably fatal, but they do not by any means furnish the chief sources of danger. These result partly from the respiratory efforts which are always excited by delay in extracting the after-coming head, and partly from the depressing influence exercised upon the fetal heart by pressure brought to bear upon the base of the brain.†

Having thus made out, with great care, a full bill of particulars, embracing all the acknowledged drawbacks to the performance of version in narrow pelves, we have next to consider how far these associated evils tend to invalidate the claim of version to be regarded as *facile princeps* among conservative measures of treatment. The following records of the individual experience of competent operators will help us to solve this question. Kormann turned in nine cases of contracted pelves. Seven children were born living and two dead. All the mothers recovered.‡ Löwenhardt turned in twenty cases of contracted pelves. Seventeen children were born alive, and three dead. Only children that outlived the first week were counted in the successful cases. The mothers recovered.# Goodell reports eleven cases. Seven children were alive at birth, and four were still; but of the latter, one was extracted through a pelvis measuring only two and a half inches conjugate diameter, and in one the case was complicated by eclampsia. The mothers recovered. Now, not to go beyond these forty cases, we obtain, as the result of version, thirty-one living infants, without the sacrifice of a single mother. A number of the women in whose previous labors craniotomy had been found necessary were delivered by version of living children. Löwenhardt placed in contrast his own experience with the forceps in narrowed pelves presenting degrees of contraction corresponding to those in which he had resorted to version. In forty-five deliveries, sixteen children were born dead and five died shortly after birth. Of the mothers, three died, while twenty-one suffered from puerperal affections of greater or less severity.

Now, if the foregoing testimony represented the entire truth, there would be no good reason for discussing other plans of treatment. They, in fact, show only how far special training and experience will enable an operator to overcome difficulties by dexterity and address. In the first case reported by Dr. Goodell the child was still-born. In commenting upon the cause of death Dr. Goodell states frankly:

* C. Ruge, Verletzungen des Kindes durch Extraction bei Beckenlage, Ztschr. f. Geburtsh., Bd. i, p. 68.

† Dohrn, Ueber Pulslosigkeit des Kindes während Extraction an den Füssen, Arch. f. Gynæk., Bd. vi, p. 365.

‡ Kormann, Arch. f. Gynæk., Bd. vii, p. 13.

Löwenhardt, Wendung und Extraction das dominirende Verfahren bei Beckenenge, Arch. f. Gynæk., Bd. vii, p. 421.

"Much force was needed to extract the head, but it was not made as promptly and efficiently as I have since learned to make it." *

Another side of the question has been presented by Borinski,† who, at the instigation of Professor Spiegelberg, collected the statistics of version in contracted pelves from the Breslau Clinic between the years 1865–1872. In all there were ninety-three cases. Thirty-four children were saved, and fifty-nine were born dead, or died soon after birth. Fifteen mothers lost their lives. This seemingly disastrous showing is capable, however, to a certain degree, of explanation. Thus, twenty of the fifty-nine children born still died before version was attempted. In nine of the cases the transverse as well as the conjugate was materially diminished. Of the children delivered through these flattened generally contracted pelves, only one, and that a very small one, was extracted alive. Still, there were fifty-eight cases of version in ordinary flattened pelves, with the result that just one half the children were born dead. In only three of the fifteen mothers who died was the fatal result apparently connected with the operation. In the others, death was due to spontaneous rupture of the uterus, placenta prævia, and nephritis, version having been resorted to because of these complications. A considerable allowance should be made, too, in the cases from the Breslau Clinic, for the fact that the greater part of them took place in the out-department of the hospital, when they were under the charge of midwives, who rarely send for timely aid except in the presence of dangerous complications. In eighteen instances the operation was performed on account of prolapse of the cord, and in eighteen instances because of some maternal affection.

Forceps.—In presenting this less favorable side of version in contracted pelves, it is well incidentally to place in juxtaposition the results of the high forceps operation as given by Dr. Harold Williams (American Journal of Obstetics, January, 1879). Williams collected one hundred and nineteen cases, reported since 1858 where the forceps was applied to the head above the brim. Of the mothers nearly forty per cent, and of the children over sixty per cent, perished. The mechanical objections to the use of forceps at the brim are obvious. When the head is molded to the contracted pelvis by the natural forces, the head passes the conjugate with its long diameter in the transverse diameter of the pelvis, with the two fontanelles on nearly the same level, and with the sagittal suture looking toward the sacrum. The posterior parietal bone rotates around the promontory, the latter producing a furrow, which runs either along the coronal suture, or at first in front of the parietal boss, and later, as flexion occurs, forward

* Goodell, Trans. of the Internat. Med. Congr., Philadelphia, 1876, p. 777.

† Borinski, Zur Lehre von der Wendung auf die Füsse bei engen Becken, Arch. f. Gynaek., Bd. iv, p. 226.

toward the frontal bone. The bilateral compression of the head is compensated for in part by a lengthening in the fronto-occipital and partly in a vertical direction.

The forceps applied in the transverse or oblique diameter of the pelvis prevents the former compensation from taking place. It increases the width of the head, and thus adds to the difficulty of passing the conjugate. Often it disturbs further the normal head mechanism by causing premature flexion and rotation to take place. In each of these ways it augments the difficulties of delivery, and renders necessary the employment of an increased amount of traction force. With forceps applied directly to the sides of the child's head I have had no experience, but Dr. Goodell,* who has clearly pointed out the objections to this method in contracted pelves, has shown that they inevitably produce flexion, and cause the large biparietal diameter to pass through the narrow conjugate. So long as the head does not engage at the brim, there is no rivalry between version and forceps. The latter should be placed under the ban as hardly less dangerous than the Cæsarean section.

Expectant Treatment.—Now, let us suppose that after rupture of the membranes it is decided to resort to neither forceps nor version, but to adopt an expectant course, until circumstances arise which shall render active interference necessary. It is certain that a very considerable portion of labors in contracted pelves terminate spontaneously. Winckel † reports twenty-three cases in the Dresden Maternity in 1873, and twelve cases in 1874–'75. Of the thirty-five cases, two mothers and three children died. Osterloh ‡ reported one hundred and thirty-nine cases from the Leipsic Maternity, between the years 1863–1872, inclusive. There were one hundred and five cases where the pelves measured from three to three and a half inches. Of one hundred and six children, seven died. Of the mothers, four died. In thirty-four cases where the pelves measured over three and a half inches, two children died. All the mothers recovered. There were, however, forty-two cases in all of puerperal disease terminating in recovery. Borinsky reports from the Breslau Clinic two hundred and thirty-three spontaneous deliveries in contracted pelves, with one hundred and ninety-two living children. There were ten maternal deaths, but four were from non-puerperal intercurrent affections. Thus, in three large maternity hospitals there were in cases of contracted pelves four hundred and seven spontaneous deliveries with the loss of fifty-three children, and, from puerperal diseases, of twelve mothers. Even in pelves meas-

* Goodell, Labor in Narrow Pelves, Trans. of the Internat. Med. Congr., Philadelphia, 1876, p. 788.

† Winckel, Berichte und Studien, 1874–'76.

‡ Osterloh, Einige Beiträge zu den spontan verlaufenden Geburten bei engem Becken, Arch. f. Gynæk, Bd. iv, p. 520.

uring less than three inches, now and then, the spontaneous birth of a small living child takes place.

If we examine these results, we find that under favorable circumstances, in all but the extreme forms of pelvic contraction, Nature will do her own work with the least expense of infant life, and with a relatively small maternal mortality. On the other hand, the long-continued pressure upon the parturient canal incident to the molding and adaptation of the head to the narrow pelvis, yields a large contingent of inflammatory affections, which complicate the puerperal period and protract the convalescence. By favorable circumstances we mean a presentation and position of the child's head suited to the form of the pelvis, and a sufficient degree of uterine activity. Rectification of a faulty position of the head after the rupture of the membranes is always a matter difficult of accomplishment. In case, therefore, the brow presents, or the head engages with an excessive degree of lateral obliquity (sagittal suture looking forward toward the pubes, or backward toward the promontory), in place of wasting time in futile efforts at correcting the malposition, version should be promptly performed. In prolapse of the cord, which occurs in about six per cent. of the cases, the indication would clearly be version rather than replacement. In eclampsia and face presentations most operators would preferably resort to version.

Thus, we have finally the field of controversy between version and other plans of treatment narrowed down to cases in which, after rupture of the membranes, the head remains above the brim, but the conditions are such that Nature is capable of overcoming the mechanical difficulties of delivery providing that the labor-pains are sufficiently energetic. There is always an element of chance in this last condition, which, however, is an essential one. If the pains are weak and powerless, it may be possible, even hours after rupture of the membranes, when the head has not become fixed, to still accomplish version. More frequently, however, as the head but incompletely fills the lower segment of the uterus, the waters escape, the uterus retracts upon the fœtus, the cervix becomes œdematous and tender, and after a time the temperature and pulse rise, betokening the presence of danger. Sometimes the retraction of the uterus ends in the withdrawal of the cervix over the child's head, and, in the failure of the latter to descend into the pelvis, the vagina is drawn upward, and subjected to a perilous degree of tension. It is easy to see that under such circumstances the time for version is past, and craniotomy is called for. Because, therefore, where labor is left in contracted pelves to the spontaneous efforts of Nature, in a certain proportion of cases the insufficiency of the labor-pains leads to the necessity of sacrificing the child, there will always be operators who, confident in their own skill, will prefer to turn soon after rupture of the membranes, that they may

keep in their hands the control of the delivery. The bulk of professional men will, on the contrary, so long as spontaneous delivery is probable, prefer to wait, even though by so doing they may eventually find themselves obliged to fall back upon the perforator and the crotchet.

When the birth of the child is left to the contractions of the uterus, re-enforced by the expiratory muscles, the physician should assume the *rôle* of a watchful spectator. Safety to the mother and the child requires that the time of the passage of the head through the bony canal should not be too prolonged. So long as the head descends steadily, however slow the progress may be, in case no complications demand speedy extraction, the physician should await the results of uterine activity. Should the pains grow weak and inefficient, they may be stimulated by the uterine douche, the introduction of the catheter into the uterus, and by small doses of ergot or the viscum album, provided the inertia is not the result of pathological changes in the uterine tissues.

When the advance of the head ceases, either from failure of the pains or, as in justo-minor pelves, from the growing resistance of the pelvic outlet, the rule should be to relieve the soft parts of the mother as speedily as possible from the pressure of the child's head. Pressure too long continued ends in œdematous swelling, softening of the tissues, arrest of circulation, and eventually in necrosis and gangrene. When the integrity of the lower segment of the uterus has been impaired to any extent, perforation should be resorted to, and the child sacrificed to the interests of the mother. If, on the contrary, the changes are insignificant, and the mechanical difficulties not insuperable, by the use of forceps it may be possible to save the life of both mother and child. But to avoid the first-named cruel alternative, the forceps should be applied so soon as the requisite conditions for its employment are reached. Of course, as the forceps is used solely to save fetal life, in case the feeble heart-action of the child gives warning of impending asphyxia the interests of the mother are to be alone consulted.

In estimating the mechanical difficulties to be overcome by the forceps, it is necessary to determine how far engagement has taken place. Litzmann * recommends that the physician ascertain by internal examination, combined with external palpation, both the size of the segment of the cranium below the brim and how much of the head remains to undergo compression before it can enter the pelvis.

In ordinary flattened pelves, Litzmann found that in three fourths of all the cases the pains alone sufficed to overcome the resistance of the brim. When the head had so far descended that the sagittal suture

* Litzmann, Ueber die Behandlung der Geburt bei engem Becken, Volkmann's Samml. klin. Vort., pp. 715 *et seq.*

had passed from three to four fifths of an inch below the promontory, and the boss of the anterior parietal bone could be felt with ease behind the symphysis pubis, extraction with the forceps was a task of no great difficulty, even if before its application flexion had not begun to take place.

In generally contracted flattened pelves, it is desirable that the head should be transverse and well flexed, with the posterior parietal bone at least three fifths of an inch below the promontory. With the forehead and occiput resting upon the side walls of the pelvis, the sagittal suture near the promontory, and an ear felt behind the symphysis pubis, the prospects of forceps operations are extremely dubious.

In justo-minor pelves of moderate extent (conjugate three and a half inches), the failure of the pains, which forms the necessity for forceps, is rather the result of the paralyzing effect of the pressure of the bony canal upon the entire circumference of the cervix than of the absolute degree of pelvic contraction. The head descends in a state of complex flexion, with the large fontanelle at the pelvic brim. If, as the head advances, the small fontanelle moves from the median line, and the large fontanelle becomes accessible to the finger, it is likely that the pelvis widens toward the outlet. If the forceps serves only to bring the fontanelle down still deeper, and to increase the declivity of the sagittal suture, the opposite condition obtains, which may frustrate the delivery.*

In flattened pelves the forceps should be applied as nearly as possible to the fronto-occipital diameter of the head, as the latter needs to descend into the transverse diameter of the pelvis. When applied obliquely it tends to cause premature rotation, which increases the difficulties of extraction. In justo-minor pelves the direction of the blades is of less importance, as the head often descends spontaneously in an oblique diameter. Success in high forceps operations depends upon the degree of accuracy with which the tractions are made in the axis of the pelvis. With the long-curved forceps, it is especially difficult to fulfill this requirement at the superior strait. Even when the directions to draw vertically downward are faithfully carried out, a considerable portion of the force is expended in the pressure of the forceps upon the soft tissues lying between them and the anterior pelvic wall. In careless hands this pressure is capable of inflicting a great deal of injury, particularly where the blades of the forceps are passed within an imperfectly dilated cervix, and where they project somewhat beyond the child's head. Various devices have been invented to correct this defective working of the instrument. Pajot recommends placing the left hand upon the lock to make pressure backward, while with the right hand tractions are made downward and somewhat for-

* Litzmann, Ueber die Behandlung der Geburt bei engem Becken.

ward. I have generally succeeded by exerting a small amount only of force at each traction, watching at the same time with great care the direction of the blades in the pelvis. This method is pretty safe, and in the end generally successful, but often requires a very considerable outlay of time and patience. A pair of straight forceps, as recommended by Dr. I. E. Taylor, will often enable one to draw more directly in the axis of the brim, and will succeed when the curved forceps have had to be abandoned. Of late I have been in the habit of using Tarnier forceps in high operations, and am able to give it my cordial approval. The blades always swing in the transverse diameter of the pelvis, while the traction force is exerted as nearly as possible upon the center of the child's head. A few trials will convince the most prejudiced opponent of the Tarnier forceps that it will at the superior strait bring the head to the floor of the pelvis in much less time, and with a less expenditure of force, than can be accomplished by other methods.

The dangers from the forceps in contracted pelves are due not so much to the pressure it makes directly upon the child's head and the pelvic walls as to the compensatory bulging of the head in its transverse diameter. When the head is fixed at the brim and the forceps is applied to the forehead and occiput, it is evident that the only change of form that can take place is in a vertical direction. Safety in delivery requires that there should be no sudden augmentation of the bilateral pressure, which would necessarily deepen the furrow made by the promontory upon the posterior-lying parietal bone, and imperil the integrity of the maternal tissues confined at the conjugate between the promontory and the pubes. Until, therefore, the head has passed the narrow strait, tractions should be made with moderate force, and with short periods of intermittence. After the head has once descended to the floor of the pelvis the forceps should be removed, and the head be allowed to rotate into the conjugate, then a forceps of any pattern may be adjusted to the sides of the head, should further aid be required to complete delivery.

So far we have considered cases in which the cervix was sufficiently if not completely dilated before rupture of the membranes. If, as is very common, the membranes rupture prematurely, the difficulties and risks to both mother and child are greatly increased. With rupture come, as we have already seen, escape of the amniotic fluid, retraction of the uterus, and interference in the utero-placental circulation. With an undilated os externum the cervix is stretched by the head, and its thinned tissues are subjected to pressure from the symphysis and promontory. Delay leads to arrest of circulation and necrosis at the points of pressure, but here version and forceps are alike impracticable. This leaves as the only alternatives perforation and the Cæsarean section. Timely aid, therefore, in such cases should

be extended before a dangerous condition is reached. My first preference just after rupture is the Barnes dilator, which not only serves to expand the cervix, but, when employed promptly, helps to prevent the escape of the amniotic fluid. Next to the Barnes dilator, and of special utility when the waters have already escaped, I would place the long, narrow-bladed forceps of Dr. Taylor for introduction through the undilated os. With it the head can be grasped, and, when made to descend and then allowed to recede in alternation, oftentimes the rounded cranial surface will efficiently act as a dilating body, and secure such a degree of expansion as will pave the way for the safe adoption of other methods of delivery.

CHAPTER XXVII.

RARE FORMS OF PELVIC DISTORTION.

The Naegele oblique pelvis: morbid anatomy, etiology, diagnosis, mechanism of labor in, prognosis, treatment.—The kyphotic pelvis: morbid anatomy, etiology, diagnosis, prognosis.—Scolio-rachitic pelvis: anatomical characters.—Robert's pelvis: anatomy, etiology, diagnosis, prognosis.—Spondylolisthetic pelvis: anatomical characters, diagnosis, prognosis.—Funnel-shaped pelvis.—Osteomalacia.—Pelvis narrowed by exostoses.—Divided symphysis.

I. The Naegele Oblique Pelvis.

This variety of deformed pelvis derives its name from the author who first systematically studied it and called attention to its importance as a cause of obstructed labor.

Morbid Anatomy.—The pathological characters peculiar to this variety of deformed pelvis are, according to the classical description of Naegele,* the following: 1. Complete anchylosis of one sacro-iliac synchondrosis, or osseous union between the sacrum and one os innominatum. 2. Destruction or defective development of the lateral half of the sacrum and smaller caliber of the anterior sacral foramina on the anchylosed side. 3. Diminished breadth of the os innominatum and of the sacro-sciatic notches on the same side. The articular facet of the ilium, which corresponds to the sacral auricular surface, is less elongated than on the non-anchylosed side. 4. The sacrum is displaced toward the anchylosed side, and its anterior surface is turned in that direction. The pubic symphysis is pushed to the healthy side, and is therefore not directly opposite the promontory. 5. The internal surface of the os innominatum on the deformed side is flatter than the corresponding sound bone, and the *linea ilio-pectinea* is but slightly curved.

* Naegele, "Das schrägverengtes Becken," Mainz, 1850, p. 7.

6. The sound side of the pelvis is not of an entirely natural shape, as is shown by the fact that its ilio-pectineal line is straighter posteriorly, and more curved anteriorly, than in a normal pelvis. 7. The results of the deformities mentioned are:

(*a*) That the pelvis is contracted in that oblique diameter measured by a line passing from the acetabulum of the anchylosed side to the opposite sacro-iliac joint, while the other oblique diameter is not shortened, but even elongated in extreme cases. (*b*) That the distances between the promontory and either acetabulum, and those between the apex of the sacrum and the spine of either ischium, measured from the affected side, are less than the corresponding distances on the other. (*c*) That the distances between the tuber ischii of the anchylosed side and the posterior superior spinous process of the opbosite ilium, and those between the spine of the last lumbar vertebra and the anterior superior spinous process of the diseased side, are shorter than the corresponding distances on the opposite side. (*d*) That the distance of the superior posterior iliac spine of the anchylosed side from the lower border of the symphysis pubis is greater than that between the

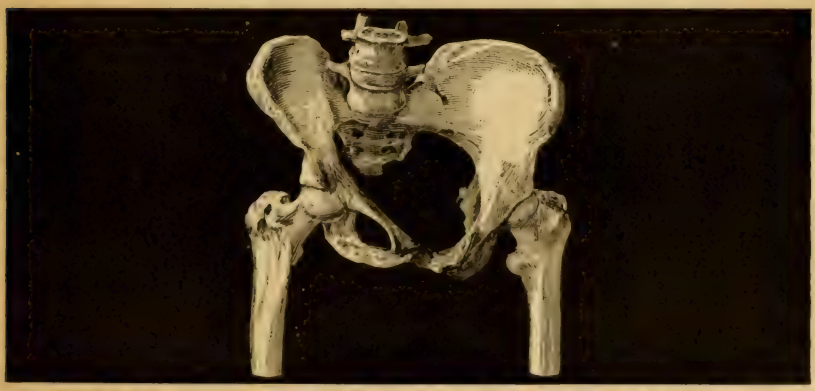


Fig. 213.—Naegele oblique pelvis. (From specimen in the Wood Museum.)

symphysis and the opposite posterior superior spinous process. (*e*) That the walls of the pelvic cavity converge below, and that the pubic arch is narrowed and approximated to the type of the male arch. (*f*) That the acetabulum of the flattened side is directed farther forward than is normal, while the opposite acetabulum looks almost directly outward. We may add that the anterior surfaces of the bodies of the lumbar vertebræ are directed toward the anchylosed side. The ilium is higher, steeper, flatter, and reaches farther backward on that side. The pubic arch looks toward the flattened side. The *conjugata vera* is somewhat elongated. The transverse diameter is shortened at the inlet, and its shortening progressively increases as the outlet is approached.* The

* Schroeder, Lehrb., p. 596.

os innominatum of the healthy side is somewhat displaced outward, and is more markedly curved, hence the venter of the corresponding ilium is directed more anteriorly than that of the anchylosed side.* The deformity is most apparent at the inlet, which is compared by Naegele to an oblique oval figure. The tuber ischii on the anchylosed side is higher, and directed more posteriorly and internally than normal. This description will also apply to the ordinary oblique-ovate pelvis, except so far as the anchylosis, which is the distinguishing feature of the Naegele oblique, is concerned.

Etiology.—The essential cause of oblique-ovate pelvis in general is continuous pressure directed against one of its lateral halves, the weight of the trunk falling predominantly or exclusively upon the lower extremity of the deformed side, and leading to displacement and distortion of the pelvic bones. The conditions producing this predominant unilateral pressure are tabulated by Litzmann † as follows: 1. Lateral spinal curvature, usually of rachitic origin. 2. Impeded or entirely abrogated function of one lower extremity. In this case the deformity will affect that side the lower extremity of which is intact. ‡ The impairment or loss of function may result—(*a*) from unilateral hip-disease; (*b*) from amputation of one lower extremity; (*c*) from an old dislocation of the femur upward and backward. 3. Unsymmetrical sacrum, produced by defective development, or by atrophy of one sacral lateral mass—(*a*) as the result of a defect in the original formation; (*b*) as the result of abnormal coalescence of the sacrum and ilium in early life, whereby the growth of both was hindered; (*c*) as the result of a loss of substance from caries. Spiegelberg # calls attention to Lambl's statement that primary asymmetry of the sacrum may be due to coalescence of the sacral lateral masses and the transverse processes of the last lumbar vertebra, whereby the outward growth of the former is impeded. He also emphasizes ‖ the fact that simple chronic arthritis of the sacro-iliac synchondrosis produces sacral asymmetry, without anchylosis, by inducing contraction and atrophic sclerosis of the contiguous osseous tissue. The continued use of one shortened lower extremity is another cause of excessive pressure upon the corresponding side of the pelvis. When this condition obtains, the deformity will be on the side of the shortening. The sacro-iliac synostosis, which has been alluded to as the distinguishing characteristic of the Naegele oblique, as contrasted with the other forms of the olbique-ovate pelvis, is sometimes the primary defomity, as will be seen from the foregoing etiological table. The coalescence of the joint-

* Litzmann, Die Formen d. Beckens, Berlin, 1861, p. 69.

† Litzmann, *op. cit.*, p. 68.

‡ Gusserow, Arch. f. Gynaek., Bd. xi, 1877, p. 264.

Spiegelberg, Lehrb., p. 475.

‖ Spiegelberg, Arch. f. Gynaek., ii, 1871, pp. 159 *et seq.*

surfaces is never, however, congenital, because the articulation is fully formed before the appearance of the centers of ossification for the sacral lateral masses. Nor can the synostosis be referred to involvement of the joint-surfaces in the process of ossification, since this does not occur in any true joint. The disappearance of the joint-cavity must, therefore, be referable to an inflammatory process, resulting in adhesion of the opposed articular surfaces. The inflammation may be either of traumatic or of strumous origin. The results of unilateral pressure upon the pelvis will depend upon the amount of pressure exerted, the resistance of the bones, and the firmness of their connections.

Diagnosis.—The attention of the obstetrician will be directed to the possibility of the existence of the oblique-ovate pelvis when the subject limps and presents an inequality in the height of the hips or evidences of antecedent gluteal abscesses. The diagnosis is assured by a physical examination, which shows, in the first place, the distance between the spinous process of the last lumbar vertebra and the posterior superior spinous process to be considerably less on the deformed than on the healthy side. The absence of this sign is, however, no proof of the non-existence of the deformity. The distorted ilium is higher than the other, and projects farther posteriorly than is normal. A vaginal examination reveals the straight course of the ilio-pectineal line on the side of the anchylosis, the deviation of the subpubic arch toward that side, a disparity in the distances between the ischiatic spines and the apex of the sacrum, and the deviation of the promontory. Naegele* suggested, for the completion of the diagnosis, the application of the following measurements, which are equal on both sides in the normal, but different in the oblique-ovate pelvis: 1. The distance of the tuber ischii of one side from the posterior superior iliac spine of the other; on the deformed side it is shorter. 2. That from the anterior superior to the posterior superior spine of the other side; shorter from the anterior spine of the deformed side. 3. That from the spine of the last lumbar vertebra to the anterior superior spinous process of the same side; less on the contracted side. 4. That from the trochanter major to the opposite posterior superior spinous process; shorter when measured from the affected side. 5. That from the under surface of the symphysis pubis to the posterior superior iliac spine; longer on the narrowed side. These measurements are only of avail in well-marked cases, and may lead to erroneous conclusions if other diseases of the bones be simultaneously present. The vaginal examination affords, on the whole, the most accurate results.

Mechanism of Labor.—The mechanism of the birth, in an oblique-ovate pelvis, is the following: If the promontory be retreating, the sagittal suture of the fetal cranium enters the inlet parallel to the

* Naegele, *op. cit.*, p. 174.

longer oblique diameter. If, however, the promontory project considerably, and is closely approximated to the ilium of the affected side, no portion of the head can be admitted between them.* The cranium will then enter the pelvis most easily with the sagittal suture in the short oblique diameter, and will pass through the pelvic canal without rotation. If the pelvis be originally small and the deformity marked, the obstruction to labor may be complete. Should the pelvis, however, be roomy and the promontory retreating, no considerable impediment will be offered to parturition.

Prognosis.—It is obvious that the prognosis, for both mother and child, is best when the pelvis was originally large, and far less favorable under the reversed condition. In the latter case the mother very frequently succumbs and the child is only rescued by the Cæsarean section. Litzmann's † statistics report the death of twenty-two out of twenty-eight mothers, five of whom perished undelivered, and that of thirty-one children out of forty-one cases. These figures by no means, however, fairly represent the average result, since many cases of slight and moderate deformity escape detection.

Treatment.—In a case of extreme obliquity at the Bellevue Hospital, where the distance between the ischia barely exceeded two inches, I induced premature labor at presumably the twenty-ninth week. The child was turned and lived long enough after extraction to receive the rite of baptism. The mother made a speedy recovery. This case affords a striking contrast to those reported by Litzmann. Undoubtedly, if the obliquity were always recognized at a sufficiently early period of pregnancy, the induction of premature labor would favorably change the prognosis. Very commonly, however, the condition passes unperceived until delay in labor leads to a more careful investigation. In such cases, if the head has entered the pelvic cavity, and the diminution of the space between the ischia is not excessive, a careful attempt should be made with the forceps to test the adaptability of the presenting part to the contracted diameter. Violent tractions should, however, be avoided. Studley ‡ has recently reported a case of coxalgic oblique pelvis in which fracture of the pubic rami upon the right side resulted from forceps delivery. If the disproportion is such that moderate tractions are unavailing to advance the head, or if the child is already dead, perforation should be performed. Craniotomy at the inferior strait is much less dangerous than at the brim.

If the head fail to enter the pelvis, we have to inquire whether the result be due to absolute deficiency of the pelvic space, or to the fact that the sagittal suture of the head corresponds to the shortened oblique diameter. In the first event the case becomes a suitable one for Cæsarean section, while in the second version should be performed

* Litzmann, Monatsschr. f. Geburtsk., xxiii, 1864, p. 268.
† *Ibid.*, p. 284. ‡ Am. Jour. of Obstet., 1879, p. 269.

with a view to bringing the long cephalic diameter into correspondence with the opposite longer diameter of the pelvis. If extraction is then found to be impossible, perforation can still be performed upon the after-coming head.

II. The Kyphotic Pelvis.

Morbid Anatomy.—The characteristic deviations of a kyphotic pelvis from the normal type are due to the unnatural direction in which the weight of the superimposed trunk is communicated to the base of the sacrum, as the result of an existing antero-posterior spinal curvature. If a dorsal kyphosis be entirely compensated by a lumbar lordosis, the former may entail no pelvic distortion. As a rule, the deformity is most marked with lumbar and sacral kyphoses, which admit of no compensatory lordosis, and least apparent with remote dorsal kyphoses. The effect of the altered direction, in which the weight of the trunk is transmitted to the sacrum, is to force the latter more deeply between the ossa innominata and to rotate its upper portion in a posterior direction. The displacement backward of the inferior extremity of the trunk causes the center of gravity to be thrown far behind the acetabula, and produces a consequent diminution in the obliquity of the pelvis by elevating the anterior pelvic parietes.* The change in the pelvic obliquity is antagonized by the ilio-femoral ligaments, and the result of these opposing forces is as follows: The sacrum is narrowed and elongated by the traction from behind and above, and its upper part is displaced backward. Its transverse concavity is increased and its longitudinal concavity diminished.† The bodies of the sacral vertebræ are on a plane posterior to their transverse processes. The promontory is high and is directed far backward. The upper anterior surface is sometimes convex while the concavity of the lower part is preserved, and an S-like shape is

Fig. 214.—Specimen of kyphotic pelvis. (Litzmann.)

* Lange, Arch. f. Gynaek., Bd. i, 1870, p. 231.

† Breslau, Monatsschr. f. Geburtsk., Bd. xxvii, 1866, p. 319.

thus imparted to the sacral curve. The higher anterior sacral foramina look upward. Owing to the tension of the ilio-femoral ligaments, the anterior inferior spinous processes of the ilium are well developed. The *lineæ ilio-pectineæ* are only slightly curved. The subpubic arch is narrowed. The spines and tuberosities of the ischia are abnormally approximated. Owing to the narrowness of the sacrum, the posterior superior iliac spines are in close proximity to each other, while the spines and crest of the ilium are more remote than in a normal pelvis. The venters of the ilia are expanded and directed to the front. The transverse diameter of the false pelvis is therefore increased, while that of the true pelvis is diminished. The symphysis is prominent, the horizontal pubic rami meeting at an acute angle. At the inlet the oblique and the conjugate diameters are elongated and the transverse diameter curtailed. In the true pelvis the transverse diameters are considerably and the antero-posterior diameter slightly shortened. These diameters become still more contracted as the outlet is approached.* If a lumbo-sacral kyphosis be present, the sacrum is shortened and very narrow. If this kyphosis be situated very low down, it may be compensated for by a low lumbar lordosis, which overhangs and materially contracts the pelvic inlet.†

Etiology.—The cause of the spinal curvature resulting in kyphotic pelvis is usually caries of the vertebræ.

Diagnosis.—The antecedent history and the discovery of kyphosis will render the existence of this form of pelvis probable. On more careful physical examination, the shape and position of the sacrum, the short interval between the spines and the tuberosities of the ischium and the posterior superior iliac spines, the wide separation of the anterior superior iliac spines, the narrow pubic arch and prominent symphysis, the flatness of the iliac venters, and the difficulty experienced in reaching the promontory, will establish the diagnosis. The differential diagnosis between a kyphotic pelvis and one deformed by osteomalacia, with which it is sometimes confounded, will be readily made by reference to these distinctive features and to the fact that the transverse diameters of the false pelvis are elongated in a kyphotic pelvis, the reverse obtaining in osteomalacia.

Prognosis.—The amount of obstruction offered to parturition will naturally depend upon the grade of the pelvic contraction. The prospects for the preservation of the child's life are not very favorable. In some instances, as in a case reported by Korsch,‡ there existed a considerable amount of mobility in the pelvic joints, which permits an enlargement of the outlet and facilitates the parturient process. The

* Hüter, Ztschr. f. Geburtsh. u. Gynaek., Bd. v, 1880, p. 22.

† Fehling, Arch. f. Gynaek., Bd. iv, 1872, p. 2.

‡ Korsch, Ein während der Geburt constatirter Fall von Beweglichkeit der Gelenkverbindungen des kyphotischen Beckens, Arch. f. Gynaek., vol. xix, p. 475.

gravity of the prognosis as regards the mother is the result in most instances, not so much of the mechanical difficulties of delivery, as of her feeble vitality, and the undeveloped condition of her heart and lungs. Again, the spinal disease may be reawakened by pregnancy, and in childbed may lead to psoas abscess, and other suppurating processes. In many cases the head enters the pelvis with the occiput rotated to the rear. Owing to its smaller size the forehead is better adapted for engagement beneath the narrow pubic arch than the occiput, but perineal laceration is more likely to occur, as the uterine force in fronto-anterior positions is directed to the center of the perinæum.

Treatment.—In first pregnancies it is a good rule to await the end of gestation, as experience has shown that Nature may accomplish the delivery, owing to the mobility of the pelvic bones, when the results of the pelvic measurements would seem to indicate this to be impossible. Before resorting to craniotomy, a careful trial should be made in head presentations with forceps. After the head has entered the pelvis the extraction of the child after craniotomy is usually not difficult. With the head movable at the brim, neither craniotomy nor version are practicable. The Cæsarean section is indicated. If the kyphosis is extreme, so that the ribs overlap the ilia, the Porro method possesses the advantage of furnishing more space for the overcrowded pelvic and abdominal viscera.

III. Scolio-rachitic Pelvis.

A brief allusion must be made to the anatomical characteristics of a purely rachitic pelvis, in order to render the differences between it and a scolio-rachitic pelvis intelligible. The leading pathological features of the infantile rachitic pelvis consist in expansion of the subpubic arch, prominence and lowering of the promontory, widening and elongation of the sacrum, flatness of the venters of the ilia, between which there is an abnormally wide interval, and in an irregularly rounded, triangular, or kidney-shaped pelvic inlet.* These anatomical features are not altered by the supervention of a scoliosis, but the latter adds to the deformity already existing its own pathological characters. The latter combine to produce a marked unilateral asymmetry of the pelvis.† The most ordinary form of scoliosis consists in a deviation of the dorsal vertebræ to the right and a compensating lumbar curve to the left.

The adult scolio-rachitic pelvis presents many points of resemblance to the infantile, its leading peculiarities being the following:‡ The entire pelvis is inclined toward the side of the lumbar curve, and rests chiefly upon the corresponding thigh. The cause of the pelvic asym-

* Fehling, Arch. f. Gynæk, Bd. x, 1876, p. 1; *Ibid.*, Bd. xi, 1877, p. 173.

† Kehrer, Arch. f. Gynæk., Bd. v, 1873, p. 60.

‡ Leopold, Das skoliotisches und kyphotisch-rachitisches Becken. Leipsic, 1879, p. 7.

metry is to be sought in the increased weight thus thrown upon the contracted half of the pelvis and in the counter-pressure exerted upon its articular surface. The contracted half of the pelvis is higher and more inclined than its fellow. The sacrum has sunk deep between the ilia, and is narrower upon the side of the lumbar scoliosis. The sacral vertebral bodies are sometimes displaced forward, projecting beyond the lateral masses. The promontory is displaced toward the contracted side, and the corresponding lateral mass is often narrowed. There is rarely anchylosis of the hip-joint. The ilium is erect, looks inward, and is narrowed antero-posteriorly. Its crest is higher than that of the opposite side. The symphysis is displaced toward the uncontracted half of the pelvis. The ilio-pectineal line makes a sharp curve inward near the sacro-iliac synchondrosis, and then pursues an undulatory course to the symphysis, being notably bent inward opposite the acetabulum. On the uncontracted side the corresponding line forms a large and rounded arch. The tuber ischii on the side of the lumbar scoliosis is turned outward. The oblique diameter of this side is greater, but the distance between the sacrum and the acetabulum (*distantia sacro-cotyloidea*) is much shorter than on the uncontracted side. The plane of the inlet is obliquely cordiform, being contracted upon the side of the lumbar scoliosis and expanded on the other. Exactly the reverse conditions obtain at the pelvic outlet.* The conjugata vera is notably shortened by the protruding promontory. The antero-posterior diameter of the outlet, although contracted, still far surpasses the conjugata vera in length. Other and independent pathological conditions may aggravate the obstruction caused by the peculiar deformity in question. Thus, Hugenberger describes a case of scolio-rachitic pelvis complicated by an extensive sacral hydrorachis.†

Fig. 215.—Specimen of scolio-rachitic pelvis. (Litzmann.)

The peculiar deformity of a scolio-rachitic pelvis obstructs delivery by so narrowing the space between the acetabulum and the

* Leopold, *op. cit.*, p. 10.

† Hugenberger, Arch. f. Gynaek., Bd. xiv, p. 1.

sacrum as to prevent any part of the fetal cranium from engaging in it. Rotation is thus prevented, and the delivery must be accomplished, if indeed it be possible, by the same mechanism obtaining in a justo-minor pelvis, the conjugata vera of which would be here represented by the distantia sacro-cotyloidea, and the transverse diameter of which would correspond with the oblique diameter of the uncontracted side.

IV. Robert's Anchylosed and Transversely Contracted Pelvis.

This very rare form of contracted pelvis was first described by Robert in 1842. Its leading characteristics are bilateral sacro-iliac anchylosis and absence or rudimentary development of the sacral lateral masses. The sacrum is consequently very narrow, and only slightly wider at its upper than at its lower extremity. The longitudinal and transverse concavities of the bone are nearly or quite obliterated. In some cases the normal transverse concavity is transformed into a convexity. The sacrum is deeply pressed between the ossa innominata. The posterior superior iliac spines are consequently closely approximated, and the ilia project far above the base of the sacrum. The promontory encroaches considerably upon the superior strait. The iliac venters are flattened and directed anteriorly. The lineæ ilio-pectineæ are slightly or not at all curved, and abnormally approximated. The descending rami of the pubes unite at an acute angle. The ischiatic spines and tuberosities are in close proximity to each other and to the lateral margins of the sacrum. The dimensions of the pelvis are materially altered.

Fig. 216.—Robert's pelvis. (Lambl.)

The transverse diameter is notably diminished and grows shorter from above downward, so that at the outlet, in marked cases, it is represented by a mere crevice between the ischia and the pubic bones. The form of the inlet is that of a long and narrow wedge with its apex directed anteriorly. The average diameter of the outlet is less than two inches.* The antero-posterior diameter is either of normal length or but slightly shortened, since the projection of the promontory is compensated for by the absence of the normal outward curve of the lateral borders of the inlet. The pelvic canal is deeper than in a nor-

* Spiegelberg, Lehrbuch, p. 482.

mal pelvis. In some cases there is asymmetry of the two lateral halves of the pelvis.

Etiology.—The decisive agency in the production of the deformity under consideration is the narrowness of the sacrum, which is chiefly due to the diminished breadth of its lateral masses, but also in a certain measure to the small transverse diameter of the bodies of the sacral vertebræ. Diversities of opinion prevail regarding the connection between the narrowness of the sacrum and the sacro-iliac synostosis.

Some authors consider deficient development of the centers of ossification of the lateral masses as the primary event, and the anchylosis as dependent upon this. Others regard the synostosis as the primary change which determines the atrophy of the lateral masses,* and variously refer it to inflammatory processes or to arrested development.† In some cases it would seem that the sacrum was originally of normal breadth, but was narrowed and united with the ilium by osteitis and arthritis.‡ The transverse convexity of the anterior sacral surface is explained by the fact that the bodies of the vertebræ are pressed forward by the weight of the superimposed trunk after the union of the sacral lateral masses with the ilia, and at a time when the connections between the bodies and the lateral masses are still pliable and yielding. The close approximation of the ilia and their parallel course are referable to the narrowness of the sacrum and to increased lateral pressure upon the acetabula.# The combined action of these agencies produces the narrowness of the subpubic arch, the acutely angular junction of the descending pubic rami, the approximation of the iliac crests, and the straight course of the lineæ ilio-pectineæ.

Diagnosis.—The diagnosis is partly based upon the abnormal approximation of the posterior superior iliac spines, which almost cover the deeply seated spinous process of the last lumbar vertebra, and upon a similar approximation of the trochanters, of the tubera ischii, and of the iliac spines and crests. A vaginal examination then reveals the parallel course of the descending pubic rami and the striking diminution of the transverse diameter. The differential diagnosis between the Robert and the kyphotic pelves is based upon the absence of a kyphosis in the former and upon the striking difference between the respective transverse diameters.

Prognosis.—This is bad for the mother, inasmuch as labor is completely obstructed by the deformity, and operative interference is always necessary.

The Cæsarean section is indicated in the interest both of the mother and the child.

* Litzmann, Die Formen des Beckens, Berlin, 1861, p. 62.

† Kehrer, Monatsschr. f. Geburtsk., Bd. xxxiv. 1869, p. 20.

‡ Kleinwächter, Arch. f. Gynaek., Bd. i, p. 156.

Litzmann, *op. cit.*, p. 65.

V. Spondylolisthetic Pelvis.

This rare form of contracted pelvis was first described by Rokitansky in 1839. Its principal pathological feature consists in the separation of the last lumbar from the first sacral vertebra and in the descent of the body into the pelvis, where the inferior, or in an extreme case the posterior, surface of the body of the last lumbar rests upon the anterior surface of the first sacral vertebra. The anterior surface of the last lumbar vertebra is directed downward. The anterior surfaces of the fourth, third, and second lumbar vertebræ form an arch, the most prominent part of which, being nearest the symphysis, replaces the normal promontory. The result of this displacement is a considerable diminution in the antero-posterior diameter of the pelvic inlet. The descent of the lumbar portion of the spine, which is gradually accomplished, is attended by atrophy of the intervertebral cartilages, and frequently by osseous union between the bodies of the lumbar and sacral vertebræ. The weight of the superimposed trunk being now transmitted to the anterior surface of the sacrum, instead of to its base, the pelvic center of gravity is displaced forward. This is compensated for by a diminution in the normal pelvic inclination, the anterior portion of the pelvis being tilted slightly upward. The pressure upon the anterior surface of the sacrum forces its base backward. The posterior superior iliac spines are thus widely separated, and the apex of the sacrum is thrown forward, encroaching upon the antero-posterior diameter of the outlet. In a case cited by Breslau,* the sacro-iliac synchondrosis possessed great mobility.

Fig. 217.—Spondylolisthetic pelvis. (Kilian.)

The traction upon the ilio-femoral ligaments, which approximates the tubera ischii, and the lateral displacement of the ilia, due to recession of the sacrum, produce a shortening of the transverse pelvic diameter, which becomes more marked in proportion as the outlet is approached.

According to the recent investigations of Neugebauer,† the spondylolisthetic pelvis is far from being a very rare anomaly. Thus Neugebauer has succeeded in collecting from various sources twenty-three anatomical preparations and thirty clinical observations made on living persons.

* Breslau, Monatsschr. f. Geburtsk., Bd. xviii, 1861, p. 411.

† Dr. Franz Ludwig Neugebauer, Arch. f. Gynæk., vol. xix, p. 441; vol. xx, p. 133; vol. xxii, p. 347; vol. xxv, p. 347.

Etiology.—Neugebauer, who has studied with unwearied patience and zeal the anatomical specimens preserved in the museums of Europe, has shown that in true spondylolisthesis the body of the vertebra alone is concerned in the forward displacement, the arch, the spine, and the transverse processes remaining *in situ*. The spinal canal undergoes, therefore, an antero-posterior elongation, and the cord is not subjected to pressure. This elongation takes place at the junction of the arch with the body. It does not appear to be due either to caries or an inflammatory process. The original cause of the anomaly Neugebauer attributes in many cases to a congenital separation of the arch from the body of the fifth lumbar vertebra, due to defective ossification, in rare instances to traumatic fracture of the sacral articular processes, and in some cases probably to fracture of the arches due to traumatism. The latter cause he admits, however, to be hypothetical, as where fractures have been observed it is not possible to determine whether they occurred primarily, or whether they resulted secondarily from the strain placed upon them in the forward and downward movements of the vertebral body.

In a few instances the etiology remains unsolved. The deformity never occurs suddenly, but progresses slowly under the pressure of the trunk until the gliding movement is arrested by bony union between the lumbar and sacral vertebra. Repeated pregnancies furnish mechanical conditions favoring the spondylolsthesis, though pregnancy is not an essential element in the causation, as the accident has been observed in males.

Diagnosis.—As a result of the deformity, the abdomen is protuberant and the thorax is sunken between the prominent iliac crests. The trunk, therefore, appears shortened, while the extremities are relatively of disproportionate length; the width between the trochanters is increased; the nates are flattened and pointed below with deep lateral depressions, so that the posterior aspect of the buttocks possesses a heart-shape and the base of the sacrum and the posterior superior spines of the ilium are prominent. Along the spine a deep lumbo-dorsal furrow is observable, and, owing to the diminished pelvic inclination, the external genitals are directed to the front. The gait of patients suffering from spondylolisthesis is peculiar. The steps are short, the toes are but slightly turned out, and the footprints follow one another in nearly a straight line. It is not, however, easy to determine by external examination alone the difference between spondylolisthesis and a deep-seated lumbo-sacral kyphosis. The internal examination is best made, according to Neugebauer, in the upright or lateral position. To determine the existence of the angle formed by the projecting lumbar vertebra, the finger should be introduced along the anterior vaginal wall in the axis of the superior strait directly to the spinal column, and then should be passed downward to the seat of

displacement, carefully feeling in the descent the spinal vertebræ and the extent to which the spine covers the pelvic brim.

Olshausen * first announced the fact that the point of division of the abdominal aorta into the common iliac arteries is displaced downward by the descending lumbar vertebræ to such an extent as to enable the palpating finger, introduced into Douglas's *cul-de-sac*, to detect pulsation in these vessels. Hartmann † was enabled to feel the point of the aorta's division on the upper border of the fourth lumbar vertebra, and Breslau ‡ felt a pulsating vessel in the same situation. Neugebauer states that this displacement is not pathognomonic, but may be observed in other instances of spinal lordosis. The spondylolisthetic lordosis may be mistaken for the sacral deformity peculiar to a rachitic pelvis. Breisky * suggests that this error may be avoided by attention to the fact that in the rachitic pelvis the sacral lateral masses pass outward from the projecting promontory, while in spondylolisthesis one can feel at the pelvic inlet only the rounded prominence of a single vertebral body without laterally expanding wings. The projecting angle made by the body of the last lumbar vertebra with the anterior surface of the sacrum is also easily accessible to palpation.

Prognosis.—The prognosis in cases of the spondylolisthetic, as in other forms of contracted pelvis, depends upon the degree of the obstruction of the brim, and such collateral conditions as the size of the child, the strength of the pains, and the position of the head at the point of entry into the pelvis. Other things being equal, a deviation of the spine from the median line is a favorable condition.

Swedelin,‖ from a careful study of the clinically observed cases, concludes:

1. That where the false conjugate measures above 3½ inches no disturbance of labor is to be anticipated.

2. When the false conjugate measures from 3 to 3½ inches, pregnancy may be permitted to proceed to term, as labor at term may be expected to terminate favorably for both mother and child, without the intervention of severe operative measures.

3. Labor at term, with a false conjugate measuring between 2½ to 3 inches, is extremely dangerous for the child; the prognosis for the mother is likewise bad.

4. With less than 2½ inches in the false conjugate, extraction of the child without craniotomy is hardly possible.

* Ohlshausen, Monatsschr. f. Geburtsk., Bd. xxiii, p. 204.

† Hartmann, Monatsschr. f. Geburtsk., Bd. xxv, 1865, p. 469; Bd. xxxi, 1868, p. 285.

‡ Breslau, Monatsschr. f. Geburtsk., Bd. xviii, p. 411.

* Breisky, *loc. cit.*, p. 9.

‖ Swedelin, Ein neuer Fall von klinisch beobachteter Spondylolisthesis, Arch. f. Gynæk, vol. xxii, p. 250, 1880.

5. In multiparæ the prognosis is the more serious in cases where the previous labor was difficult.

He advises, therefore:

1. Induction of premature labor at the thirty-second week, with a false conjugate of less than $2\frac{3}{4}$ inches.

2. Induction of premature labor at the thirty-second week with a false conjugate measuring between $2\frac{3}{4}$ and $3\frac{1}{4}$ inches.

3. Between $3\frac{1}{4}$ and $3\frac{1}{2}$ inches, it is best to await the end of gestation, unless the feeble condition of the patient contra-indicates a waiting policy, in which case premature labor should be induced in the thirty-sixth week.

4. Premature labor is not indicated with a false conjugate exceeding $3\frac{1}{2}$ inches.

5. If the end of gestation has been reached with a false conjugate of less than $2\frac{3}{4}$ inches, wait until danger threatens the patient, and then decide between craniotomy and the Cæsarean section.

6. With a false conjugate of less than $2\frac{1}{2}$ inches, the Cæsarean section is called for.

VI. Funnel-shaped Pelvis.

This term has been applied to two varieties of deformed pelves, both of which are exceedingly rare. The inlet of the first variety is either normal or but slightly contracted in all its diameters, but its canal is gradually and progressively narrowed as the outlet is approached. The contraction affects chiefly the transverse diameter; but either this alone, the antero-posterior diameter alone, or both together, may be shortened. The lateral pelvic walls converge considerably, particularly in the vicinity of the outlet. The descending rami of the pubic bones are closely approximated, so that the subpubic arch forms an acute angle. The spines and tuberosities of the ischia are in close apposition.* The sacrum is elongated and but slightly curved, its position resembling that of the sacrum in a kyphotic pelvis. It will be seen that these deformities produce a close resemblance to the typical male pelvis. Pelves of this variety are frequently somewhat unsymmetrical.

The second variety of the funnel-shaped pelvis is so exceedingly rare as to require only a passing notice. In this instance the deformity is exactly the reverse of that just described, the inlet being very narrow in either one or in all of its diameters, while the outlet is of normal size or even abnormally wide in one or more directions.†

Etiology.—The causes of this deformity are imperfectly understood. The former variety is believed to be due to arrest of develop-

* Poppel, Monatsschr. f. Geburtsk., Bd. xxviii, 1866, p. 224; Braun, Arch. f. Gynaek., Bd. iii, 1870, p. 154.

† Spiegelberg, Lehrbuch, p. 472.

ment in the sacral lateral masses and to other causes co-operating to alter the direction in which the weight of the trunk is normally transmitted to the sacrum. This view seems to be confirmed by Schroeder's observation that the funnel-shaped pelvis is of unusual frequency in a certain German province, where the children are carried upon the back in a position intermediate between the erect and the recumbent posture.* The weight of the body would in this case be transmitted to the sacrum from above and in front, as in the kyphotic pelvis, rather than from behind and above, as is the case in a natural position, and the pelvis would neither acquire its normal anterior curvature nor its posterior inclination. The same theory explains the failure of the sacrum to exert its usual wedge-like action in separating the ossa innominata, and accounts for the consequent approximation of the tubera and spines of the opposite ischia.

Diagnosis.—In cases of slight deformity the diagnosis is difficult. In well-marked cases the approximation of the ischial tuberosities, the slight divergence of the pubic rami, and the acute subpubic angle are readily appreciated. Arrest of the head after it has already descended into the true pelvis will often be the first circumstance serving to direct the attention to the possible existence of funnel-shaped pelvis. Pelvic menstruation, with particular reference to the distance between the spines of the ischia and to the width of the sacrum, will establish the diagnosis.

Prognosis.—In the slighter grades of funnel-shaped pelves, the prognosis is not grave. If the deformity be marked, however, the child's life must almost invariably be sacrificed; and gangrene of the maternal soft parts, with resulting cicatrices and fistulæ, or even with caries of the pubic bones, may be the consequence of the excessive pressure to which these tissues are liable. In a case reported by Scharlau the lesions already mentioned were accompanied by perforation of the fundus uteri from gangrene, and by rupture of the right sacro-iliac artery.†

The treatment consists in the induction of premature labor, or, at term, in a cautious attempt to deliver with forceps. Should moderate tractions fail to advance the head, perforation and extraction with the cranioclast should be resorted to.

VII. Pelves deformed by Osteomalacia.

Osteomalacia is almost confined to females, and appears, ordinarily, in the puerperal state. It usually attacks fully developed bones, but may, rarely, affect them during their period of growth. It is generally observed in multiparæ, although primiparæ are in exceptional cases

* Schroeder, Lehrbuch, p. 582.

† Scharlau, Monatsschr. f. Gebartsk., Bd. xxvii, 1866, p. 1.

its victims. Each succeeding pregnancy is usually attended by a progressive development of the disease, which may, however, become non-progressive, or even be completely and permanently arrested.* In a case of this kind the bone is restored to its normal histological state, although its deformity remains. Osteomalacia may involve the entire osseous system, or be confined to individual bones. In the latter case the long bones and the vertebræ are most frequently diseased.† In puerperal osteomalacia the pelvis and the vertebræ are predominantly and often exclusively affected. The disease is regarded as an osteomyelitis, which, beginning in the center of bones, advances toward their periphery. The essential pathological process consists in the absorption of calcareous matter, through the Haversian canals, and in the substitution of hypertrophic medullary tissue for the softened osseous structures. The natural result of the changes is great friability or pliability of the bones, according to the stage reached by the disease, and their consequent distortion by compression or traction. The bones are of very light weight. Their transverse section reveals a porous, diploë-like structure. Their outer, hard lamella is exceedingly thin, or entirely absent. The bones are of a wax-like softness, being readily cut and molded. The term rubber or elastic pelvis has been applied to those pelves whose bones have reached this stage of degeneration. In the most advanced cases the osseous tissue is represented merely by membranous sacs of periosteum inclosing medullary tissue and fat.

FIG. 218.—Osteomalacia. (Specimen from Wood's Museum.)

Morbid Anatomy.—The osteomalacic pelvis presents the following pathological anatomical features: The sacral lateral masses are very narrow, and the entire bone, which is displaced downward between the ilia, is sharply curved. The promontory is accordingly deeply depressed and approximated to the symphysis as well as to the apex of the sacrum, which is itself displaced forward and curved upward. The promontory and the apex of the sacrum may, in marked cases, almost touch each other. The ilia are placed almost vertically. Their crests are elongated and sharply curved. The anterior superior spinous processes are approximated. The posterior superior spinous processes are in the same plane with the posterior surface of the last lumbar spinous

* WINCKEL, Monatsschr. f. Geburtsk., Bd. xxiii, 1864, p. 321.

† LITZMANN, Die Formen des Beckens, Berlin, 1861.

process. The iliac fossa is divided, near its middle, by a vertical furrow, which may be bifurcated at its lower end. A prominence corresponding to either acetabulum encroaches more or less upon the pelvic canal. In grave cases these prominences may even come in contact with the promontory. The pubic bones are in close apposition, and the pelvic inlet is consequently pointed anteriorly, while the symphysis is prominent and sharply angular. The ascending rami of the ischia and the descending rami of the pubes are approximated, and the subpubic arch is partly or completely abolished. The tuberosities of the ischia are approximated. The deformities described may be asymmetrical. The pelvic canal is greatly narrowed, the outlet usually suffering more distortion than the inlet. The pelvic inlet and canal are of triangular form, and assume, in the highest grades of the disease, the shape of the letter Y. The transverse diameter is always contracted, and its shortening is more marked as the outlet is approached. The approximation of the ischial tuberosities and of the pubic bones, together with the anterior displacement of the apex of the sacrum, sometimes almost obliterates the outlet.

Etiology.—The etiology of this pelvic deformity may be divided into—1. That of the original disease; and, 2. That of the resulting distortions. 1. The causes of osteomalacia are obscure. Cold and damp dwellings, insufficient air and light, inadequate aliment, and exposure are cited as exciting causes;* but it seems probable that these alone are insufficient etiological agencies unless some undetermined predisposing cause be already in operation. The disease is sometimes observed to assume an endemic form, particularly in countries where the above-mentioned exciting causes prevail, as, for instance, in the Rhine provinces and in some parts of Italy. In the United States it is only observed in isolated cases, usually in persons of foreign birth. 2. The immediate causes of the distortions are found (*a*) in the altered structure of the bones, and (*b*) in the various forces acting mechanically upon them. (*a*) The lime-salts, which impart stability to normal bones, are greatly diminished. Although it is not definitely known by what emunctories they are removed, it is probable that they are chiefly excreted by the kidneys. Gusserow states that the proportion of lime-salts in the milk of women suffering from osteomalacia is abnormally large.† Pagenstecher opposes this view.‡ (*b*) The distortions are chiefly produced, when once softening of the bones has occurred, by the muscular traction and by the pressure exerted upon the pelvic walls. This pressure will vary in direction and intensity with the different positions assumed by the patient. If the dorsal decubitis be long maintained, the sacrum is displaced forward and the ilia are

* Hennig, Arch. f. Gynaek., Bd. v, 1873, p. 519 *et seq.*

† Gusserow, Monatsschr. f. Geburtsk., Bd. xx, 1862, p. 19.

‡ Pagenstecher, Monatsschr. f. Geburtsk., xix, 1862, p. 128.

folded upon themselves, so that a vertical furrow traverses the iliac fossæ. In the erect position the sacrum is forced downward and forward, dragging with it the posterior parts of the ilia, and increasing the bend in the iliac fossa. The same effect is produced by the upward and backward pressure exerted upon the acetabula by the femoral heads. In the lateral position the ilia are forced inward, and the transverse pelvic diameter is thus diminished. In the sitting posture the apex of the sacrum and the tubera ischii are forced upward. The deviations referred to above result from excess of pressure in some given direction, or from unequal progress of the disease in the various bones.

Diagnosis.—In the earlier stages the history of violent pains in the pelvis and lower extremities will direct attention to the existence of osteomalacia, and careful mensuration will reveal beginning distortion. Pelvimetry is most satisfactorily performed during anæsthesia, which permits the introduction of the entire hand within the pelvis. If the disease be more advanced the diagnosis will be based upon the above-mentioned morbid anatomical features, chief among which are the prominent pointed symphysis, the parallel pubic rami, the approximation of the tubera ischii, the accessibility of the promontory to palpation, the curvature of the sacrum, and the folding of the ilia. Spiegelberg insists on the value of the pliability of the pelvic bones as an aid to diagnosis.* The pliability, although slight during pregnancy, is more marked in labor. Its first sign is great sensitiveness to pressure over the symphysis.† Its grade can be determined by the method recommended for pelvic measurements.

Prognosis.—The prognosis for the mother is very bad. The majority of patients succumb to the effects of pressure in labor, to the results of operative interference, or to the exhaustion attending the almost invariably progressive disease. Amelioration of the symptoms and signs sometimes occurs when conception does not recur. In very exceptional cases not only may the pathological process be arrested but the normal histological character of the bone restored. (*a*) Even in such cases, however, the pelvic deformity remains unaltered, and would sadly cloud the prognosis if conception should recur. The prognosis for the child is more favorable. In the beginning of the disease, and in cases of pliable pelvis, the child may be born uninjured.‡ In more advanced cases a fair prospect of preserving its life is afforded by a resort to the Cæsarean section.

The treatment will depend upon the results of a careful exploration

* Spiegelberg, Lehrbuch, p. 489.

† Winckel, Monatsschr. f. Geburtsk. Bd. xxiii, 1864, p. 81.

‡ Kezmarszky, Arch. f. Gynaek., Bd. iv, 1872, p. 537; Fasbender and Püllen, Monatsschr. f. Geburtsk., Bd. xxxiii, 1869, p. 177; Breslau, *Ibid*, Bd. xx, 1862, p. 355; Schieck, *Ibid.*, Bd. xxvii, 1866, p. 178; Winckel., *Ibid.*, Bd. xxiii, 1864, p. 81.

of the pelvic space. This should determine, first, whether it is possible to extract a living child through the natural passages; or, second, where that is out of the question, whether it is possible to deliver after craniotomy. In estimating the chances it will be necessary to take into consideration the pliability of the pelvis, it having been found possible in many cases of advanced softening to open up the pelvic canal with the hand and deliver by version. Lazzati and Casati, in Milan, found it was only necessary to perform Cæsarean section twice in sixty-two cases. Litzmann in 1857 reported forty Cæsarean sections in eighty-five cases; fifteen years later Hugenberger reported but four Cæsarean sections in twenty-five cases (Spiegelberg). Lately Porro's operation has been proposed by Levy in osteomalacia as a curative measure; but of this further experience is necessary.

Pseudo-Osteomalacia.—It is possible for a rachitic pelvis, in which the rachitic changes are excessive, to present a shape similar to that in osteomalacia. This form is, however, distinguishable from the latter through the hardness of the bones, their smaller size, the greater distance between the anterior superior spinous processes, and the traces of rickets in other parts of the skeleton.

VIII. Pelves deformed by Exostosis, or by Osseous Tumors.

Fractures of the pelvic bones may be the source of pelvic deformity, either by producing permanent displacement of the bones, or by leading to such extensive deposits of callus as to obstruct the parturient canal.

Multiple exostoses of the pelvic bones are of comparatively frequent occurrence, and are usually attended by multiple exostoses of the entire osseous framework.* The pelves in which they are found are, as a rule, either of the oblique-ovate or of the rachitic variety, and the combination of these deformities is naturally a serious one, since the maternal soft parts are liable to contusion and perforation at many points during parturition. The ilio-pectineal eminence is sometimes so unusually prominent and sharp as to offer an obstacle to parturition. The same is true of the pubic crest and spine. Osteo-fibromata, sarcomata, enchondromata, and carcinomata connected with the pelvic bones con-

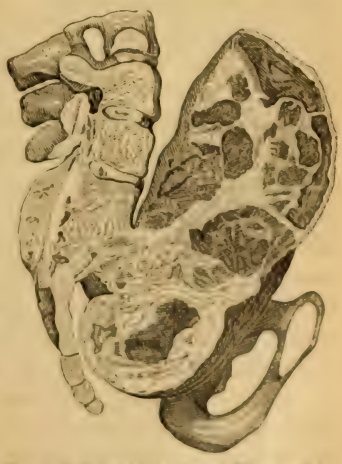


Fig. 219.—Osseous tumors filling pelvic cavity. (Naegele.)

* Leopold, Arch. f. Gynæk., Bd. iv, 1872, p. 336; Kormann, *Ibid.*, Bd. vi, 1874, p. 472.

stitute tumors of rare occurrence. They usually spring from the sacrum or from the symphysis,* and are of various dimensions. Some of them almost completely conclude the parturient canal, and may constitute formidable obstructions to delivery.

In this connection may be mentioned as of rare occurrence anchylosis of the coccyx, a condition which materially shortens the antero-posterior diameter of the outlet.

IX. Absence of the Symphysis.

In this variety of deformed pelvis the symphysis is congenitally absent, and is replaced either by strong fibrous bands extending between the opposing surfaces of the pubic bones, or by the muscles and connective tissue of the perinæum. It is accordingly designated by Litzmann the split pelvis.†

Morbid Anatomy.—It is usually attended by ectopia vesicæ and by hiatus of the abdominal wall in the linea alba. In rare cases an abdominal hiatus exists without a corresponding opening in the bladder. If the split be located immediately below the symphysis, the urethra is involved rather than the bladder, and is sometimes so defective that cystocele may occur through the abnormal opening in its anterior wall.‡ Both the external and internal organs of generation are imperfectly developed. If the anterior wall of the urethral canal be absent, the mucous membrane of the fundus vesicæ is directly continuous with that of the vaginal orifice. In other cases the bladder is only separated from the vulva by a narrow bridge. The vulva and anus are often situated more anteriorly than normal, and the perinæum is thus diminished in thickness. The clitoris is bifurcated or absent, the nymphæ are imperfectly developed, and the defective labia majora widely separated. The vagina may be imperforate or partially occluded by a transverse septum. The uterus may be double and the ovaries rudimentary.# In a case reported by Winkler, separation of the pubic bones had occurred at the symphysis, as the result of an accident in early life, and they were only connected by bands of fibrous tissue.‖ The sacrum of a split pelvis is displaced forward between the ilia, its vertical and transverse curvature diminished, and its length increased. The iliac fossæ are widely separated. The entire pelvis is greatly flattened antero-posteriorly, and strongly resembles the rachitic pelvis.

Etiology.—The cause of the existing deformity is found in the

* Harris, Am. Jour. of Obstet., vol. iv, 1872, pp. 633, 645; Braun, Monatsschr. f. Geburtsk., Bd. xxi, 1863, p. 311.

† Litzmann, Die Formen des Beckens, Berlin, 1861.

‡ Kleinwächter, Monatsschr. f. Geburtsk., Bd. xxxiv, 1869, pp. 81 *et seq.*

Litzmann, Arch. f. Gynaek., Bd. iv, 1872, p. 272.

‖ Winkler, Arch. f. Gynaek., Bd. i, 1870, p. 346.

increased pressure to which the lateral pelvic walls are subjected owing to the absence of the symphysis. The natural resistance to the separation of the lateral pelvic parietes offered by the normal symphysis being wanting, the weight of the superimposed trunk naturally forces them apart posteriorly, while the pressure of the femora bends them inward anteriorly. In some instances anchylosis of the sacro-iliac joints occurs, as a consequence of an arthritis resulting from the increased pressure thrown upon them by the lateral displacement of the ossa innominata.* In other cases sacro-iliac synostosis is not present, but the firmness of the pelvis is, nevertheless, such as to admit of unimpeded locomotion.

CHAPTER XXVIII.

ABNORMALITIES OF THE SEXUAL ORGANS.

Atresia of the genital canal.—Vulvar atresia.—Vaginal atresia.—Cystocele.—Rectocele.—Retention of urine.—Impacted calculi.—Vaginal hernias.—Cystic degeneration of the vaginal wall.—Vaginismus.—Echinococci.—Uterine atresia.—Conglutinatio orificii externi.—Cicatrical atresia.—Rigidity.—Thrombus of the cervix.—Symptoms of atresia.—Note on treatment.—Tumors.—Fibroids.—Cancer.—Ovarian tumors.

ATRESIA OF THE GENITAL CANAL. OBSTRUCTION OF THE GENERATIVE PASSAGES BY MORBID PROCESSES IN NEIGHBORING TISSUES.

I. **Vulvar Atresia.**—The term *atresia*, as here employed, implies either partial or complete obstruction of the genital canal.

Atresia of the hymen is of more frequent occurrence than any other variety of vulvar stenosis.† Unless unusually thick and rigid, however, the atresia offers only a trifling obstruction to delivery. Its chief importance is owing to the fact that it leads, in the unimpregnated state, to retention and accumulation of the menstrual fluid, which may occasion serious inflammatory, septic, or reflex nervous phenomena. Adhesions of the labia majora and minora constitute other forms of incomplete vulvar atresia. Their causes are often ulcerative processes resulting from injuries, or developed during the course of variola and other constitutional diseases. Under these circumstances they may consist of unyielding cicatricial tissue, which either ruptures in labor, or, forcing the head backward, leads indirectly to the exertion of injurious pressure upon the recto-vaginal septum or upon the peri-

* FREUND, Arch. f. Gynaek., Bd. iii. 1872, pp. 398, 406.

† JENKS, Atresia of the Generative Passages of Women, Chicago Med. Jour. and Examiner, September, 1880, p. 4.

næum. If the atresia be congenital, and not the result of cicatricial changes, it will rarely constitute an impediment to parturition. When the entrance to the vagina is very narrow, without exhibiting any pathological condition, as is often the case with aged primiparæ, it may be extensively lacerated in labor. A rigid perinæum is also well known to constitute a serious impediment to the normal progress of parturition. Œdema of the vulva, usually attendant upon albuminuria, produces atresia, and the œdematous labia and perinæum may become gangrenous from excessive pressure during labor. Vulvar hæmatoma, or thrombus, if formed, as it rarely is, before delivery, likewise obstructs the outlet of the parturient canal. A similar effect is produced by cancers and polypi of the vulva, which are, however, not often of sufficient size to occasion serious difficulty.

II. **Vaginal Atresia.**—This variety of stenosis of the generative passages is either congenital or accidental, complete or incomplete.

(*a*) The congenital form may be either incomplete, in which case the stenosis sometimes affects the entire length of the vagina, and sometimes forms a circumscribed ring-like stricture,* or it may be complete. In either case the atresia is due to arrested embryonic development, which, in the latter instance, must have originated at a very early period of fetal life. Congenital narrowing of the vagina independent of any morbid process or any arrest of development is often observed, but is of trifling consequence, being overcome by the hypertrophy and relaxation accompanying pregnancy, and by the natural expulsive forces. Absence of the vaginal canal does not necessarily imply absence or imperfect development of the uterus, Fallopian tubes, or ovaries.

(*b*) Accidental vaginal atresia may be either complete or partial, but is ordinarily of the latter form. Both varieties result from the cicatrization following superficial or deep ulceration produced by constitutional diseases or by local injury. The diseases during the course of which vaginal ulceration occurs are chiefly diphtheria, variola, typhoid fever, cholera Asiatica, and syphilis. The mechanical injuries productive of vaginal stenosis are mainly those incident to protracted labors, to the unskillful employment of instruments, or to the improper performance of obstetrical operations; but caustic local applications, pessaries, excessive coition, or any local irritant of sufficient intensity to produce ulceration, may lead to the same result. In consequence of impaired vitality, ulceration and stenosis of the vagina may follow normal labors unattended by any injurious pressure. Complete accidental vaginal atresias are produced, as a rule, by grave mechanical injuries, but may also follow the acute infectious diseases enumerated above, although the ulcerations attending the latter usually lead to only partial stenosis.

* Schroeder, Lehrbuch, 6te Aufl., p. 491.

Mention may properly be made, in this connection, of various morbid conditions involving tissue adjoining the vagina and resulting in diminution of its caliber.

Simple prolapse of the anterior vaginal wall sometimes occurs,* and, assuming an œdematous condition owing to the obstruction of its circulation, decidedly constricts the parturient canal. Cystocele frequently accompanies the prolapse of the anterior vaginal wall. If the bladder be distended with urine, the cystocele presents a tense fluctuating tumor of sufficient size to completely occlude the vagina. The subjective symptoms of this condition are intense pain with vesical tenesmus and dysuria. In some cases the cystocele is retracted by the longitudinal cervical contractions, or it may be forced still farther downward by the advancing fœtus, producing obstructed labor and even rupture of the vesico-vaginal septum.

Prolapse of the posterior vaginal wall with rectocele produces vaginal stenosis, especially if the rectum be filled with impacted fæces. This condition is easily recognized by the characteristic feeling of the fecal mass, which admits of indentation by the palpating finger.

Retention of urine becomes oftentimes a grave complication of parturition, in that the distended bladder, by displacing the uterine axis, prevents the presenting part from engaging in the superior strait. The pressure it exerts upon the uterus also interferes with the efficient contraction of that organ. The diagnosis is based upon the presence of a tumor near the uterus, and often situated laterally from it, which disappears as the urine is withdrawn through a catheter. The introduction of the latter is often extremely difficult, owing to the compression of the urethra and the retraction of the meatus urinarius within the vagina.

Vesical calculi, if of any considerable magnitude, seriously obstruct the caliber of the vagina by becoming impacted in the base of the bladder, the urethra, or a cystocele, between the fœtus and the pelvic walls. Under these circumstances not only is the labor obstructed, but contusion and rupture of the soft parts, resulting in vesico-vaginal fistula, may ensue.

Impacted calculi have sometimes been mistaken for exostoses;† but attention to the fact that they are immovable during the pains and movable in the intervals, together with the use of the vesical sound, will prevent this error.

Vaginal hernia consists of a sac formed by the protrusion of the vaginal wall, lined with the parietal peritonæum and containing some of the abdominal or pelvic viscera. The organs usually present in the sac are coils of the small and large intestine, the middle portion of the rectum with its elongated meso-rectum, parts of the omentum,

* Benicke, Ztschr. f. Geburtsh. u. Gynaek., Bd. ii, Heft 2, 1878, p. 256.

† Schroeder, Lehrbuch, 6te Aufl., p. 500.

portions of the urinary bladder, and sometimes blood, with various products of peritoneal inflammation. The location of the hernia is usually in the posterior vaginal wall, although it may insinuate itself between the uterus and the bladder, and, descending, produce hernia of the labia majora. Perineal hernias are formed by hernial sacs which pass behind the ligamentum latum and distend the perinæum. The intestinal vaginal hernia is the most important variety, inasmuch as it may not only obstruct labor, but may itself become incarcerated or strangulated, thus leading to symptoms of the gravest import. The diagnosis, which can be rendered very probable by palpation *per vaginam*, is made certain by a rectal examination.

Vaginal neoplasmata, the most important of which are carcinomata and fibromata, are rare sources of vaginal stenosis, as is likewise thrombus of the vagina. Slight obstruction to labor may result from a pathological condition of the vaginal mucous membrane described by Winckel,* under the title *colpohyperplasia cystica*, and consisting of the development in the mucous membrane of numerous small and closely aggregated flattened cysts. The cysts are believed to be produced by the distention of glandular depressions in the mucous membrane with mucus, which, according to Zweifel,† eventually produces trimethylamine gas by decomposition. Others consider the location of the gas to be in the interstices of the submucous connective tissue.‡

Vaginismus is rarely a cause of vaginal stenosis in labor, inasmuch as it is itself a cause of sterility. It has, however, been found in certain instances to constitute so serious an obstacle to delivery as to necessitate operative interference. In a recent instance in my own practice the spasmodic contraction of an unusually developed levator-ani muscle—a spasm which was uncontrolled by complete chloroform anæsthesia—rendered forceps necessary. After prolonged effort extraction was accomplished, but the head was enormously elongated. The child died of tetanus a few days after birth. In double vagina the septum is sometimes a source of slight vaginal atresia.

Intrapelvic echinococci constitute a rare cause of vaginal constriction. Wiener # collected seven cases of pelvic echinococci, most of which occupied the loose connective tissue between the vagina and rectum. The leading symptoms due to their presence during pregnancy were deep-seated traction in the pelvis, severe pain, vesical tenesmus, dysuria, and constipation. Menstruation was undisturbed. The tumors were, with one exception, so large as to completely obstruct the vaginal canal, rendering operative interference necessary.

* Winckel, Arch. f. Gynaek, Bd. ii, 1871, pp. 383, 406.
† Zweifel, Arch. f. Gynaek., Bd. ix, p. 39.
‡ Ruge, Arch. f. Gynaek., Bd. ix, p. 465.
# Wiener, Arch. f. Gynaek., Bd. vi, p. 572.

In one instance the contraction, from cicatrization of the hydatid cyst following puncture, was so extensive as to produce vaginal stenosis. Hydatids may be mistaken for exostoses of the bony pelvis, for hæmatocele, malignant intrapelvic tumors, pelvic abscesses, or cellulitis. Their differential diagnosis is based upon the presence in the pelvis of smooth, tense tumors not connected with the uterus, the gradual development of the tumors without constitutional symptoms of any gravity, the presence of similar tumors in other organs, particularly in the liver, the hydatid thrill, which is not often observed on account of the strong pressure to which the cysts are exposed, and, finally, upon the examination of the cystic fluid.

III. **Uterine Atresia.**—Uterine atresias, which occur less frequently than those of any other portion of the genital passages,* may be congenital or accidental, partial or complete. Complete atresias, observed in parturition, have become so during pregnancy, since conception would not otherwise have occurred.

Conglutinatio orificii externi, or adhesion of the lips of the os externum, is occasioned by the superficial union of the opposing mucous surfaces through the medium of inspissated epithelium or of new connective tissue resulting from adhesive inflammation produced by vaginitis or cervical endometritis. Schroeder† regards these atresias as always incomplete, and seeks their origin in the gradual induration of tissues immediately surrounding the os, resulting from old inflammatory processes. According to his views, this pathological condition consists of deficient expansibility and not of real contraction of the os externum. On examination no marked induration of the cervix is felt. The os externum is hardly perceptible to the touch, and can often only be discovered by inspection. If the examination be made during the first stage of labor the internal os is found widely dilated, while the os externum remains persistently contracted and conveys a sensation to the palpating finger akin to that produced by a narrow and tense rubber band. If the finger or an appropriate instrument be firmly pressed against the os during the pain, it slowly yields and is gradully retracted by the longitudinal cervical contractions. In default of such simple interference the cervical tissues above the os externum become enormously distended, and may finally be ruptured. Zweifel‡ refers this peculiarly unequal dilatation of the cervical canal to an abnormal presentation of the fetal cranium and to a consequent local expansion of the anterior uterine wall. The os externum having been simultaneously forced backward into the hollow of the sacrum, the yielding anterior uterine wall then forms a diverticulum which contains the presenting fetal part, and no dilating

* Jenks, *op. cit.*, p. 5.

† Schroeder, Lehrbuch, 6te Aufl., p. 487.

‡ Zweifel, Arch. f. Gynæk., Bd. v, 1873, p. 149.

force is exerted upon the external os. Benicke* was unable to discover in his cases the posterior deviation of the os which is assumed by Zweifel as the basis of his hypothesis.

Cicatricial atresia of the os externum is rarer than the adhesive stenosis just described. It is usually confined to the lips of the external os, but may involve the cervical canal for a varying distance. Its most frequent causes are *post-partum* ulceration, inflammation, cauterization of the cervix, and mechanical irritation applied for the purpose of producing abortion. The diminution of the uterine discharges during pregnancy affords a favorable opportunity for the development of the stenosis under consideration. If cicatricial atresia exist, the os externum remains undilated in labor, the cervix becomes immensely distended, and may even rupture, unless the os be dilated by artificial means. The diagnosis rests upon the discovery, usually easily made, of the cicatrized os externum. Should the latter have retreated into the hollow of the sacrum, the diagnosis may only be accomplished with difficulty, or the expanded cervical tissues be mistaken for the fetal membranes. This error is avoided by the discovery of the direct continuity of the vaginal wall and the supposed membranes, and by inspection through a proper speculum.

Abnormal rigidity of the os externum is often encountered in multiparæ as the result of genuine cicatricial processes or of fibrous hypertrophy. This condition is especially observed in connection with prolapse of the uterus. A similar rigidity in aged primiparæ is due to atrophic degenerative changes in the cervical tissues, or to hypertrophy of the portio vaginalis.†

I have met in my own practice with an instance of atresia of the os internum and of the adjacent structures, the result of cicatrices from a former labor. At the time I first saw her the patient had been several days in labor, and the waters had escaped; she had a temperature of 102°, and was delirious from pain and exhaustion. While preparing to perform the Cæsarean section, rupture of the uterus suddenly occurred, and the patient died in a few hours.

Hæmorrhages occurring into the hypertrophied cervical tissue are distinguished as cervical thrombi, and constitute obstacles to delivery. The retraction and dilatation of the cervix may, further, be obstructed by adhesions in the lower segment of the uterus between the decidua and the chorion.

Acute elongation of the anterior lip of the os externum, in consequence of its incarceration between the fœtus and the bony pelvis, and of the resulting œdema of its tissues, is referred to by Hirte‡ as a rare but serious obstacle to delivery.

Parturition is sometimes delayed by double uterus. The obstruc-

* Benicke, *op. cit.*, p. 252. † Benicke, *op. cit.*, p. 240.

‡ Hirte, Arch. f. Gynaek., Bd vii, 1875, p. 552.

tion may in this instance be produced by an hypertrophied unimpregnated horn of the uterus.* Again, the oblique position of the impregnated horn may produce abnormal presentations † or materially interfere with the efficiency of the pains.

The uterine atresias produced by carcinomata, fibromata, and ovarian tumors are considered in another chapter.

Symptoms of Atresias of the Genital Canal.—The principal symptoms of atresia in the unimpregnated state relate to the partial or complete retention of the menstrual fluids. If the stenosis be complete the uterus is enlarged and fluctuating, while severe uterine pains attend each monthly period.‡ The Fallopian tubes are dilated. Some of the retained and decomposed menstrual fluid may be forced through the tubes into the peritoneal cavity, producing serious or fatal peritonitis. The mere dilatation of the uterus may become so excessive as to produce peritonitis.# Septic poisoning is sometimes induced by absorption of putrescent materials from the uterine cavity. A symptom often serving to attract attention to the existence of abnormal vaginal contraction is inability to perform the sexual act.

The most prominent symptom of atresia during parturition consists, in general terms, of mechanical obstruction to delivery, which is more or less serious in proportion to the degree of existing stenosis. The special symptomatology of the individual pathological conditions productive of atresia has been considered in connection with their respective anatomical characters.

Note.—Atresias for the most part require to be treated each by itself, according to the principles of surgical art. In a paper by Professor I. E. Taylor, in the fourth volume of the Transactions of the American Gynæcological Society, entitled Atresia of the Vagina, Congential or Accidental, in the Pregnant or Non-pregnant Female, the author relates a case of seemingly complete imperforation of the vagina complicating labor, where he succeeded, by scraping with the finger-nail during the pains, in passing the index-finger through the intervening membrane to the child's head, and eventually in securing an opening large enough for the birth to be accomplished. I had previously reported two similar cases, one in the New York Medical Journal, and one to the Obstetrical Society.‖ The first, where I was aided by Professor Fordyce Barker, occurred in Bellevue Hospital, and the second in private practice. In both, similar success followed a gradual dissection of the vaginal walls with the finger. In such cases usually a depression, or a thinned point in the tissues, indicates the direction to be followed. C. Braun states, however, that he has seen three cases where vesico-vaginal fistulæ were produced by this tunneling process, an admonition to extreme caution in its performance.^ For stenoses of the vagina, dilatation should be employed, either by means of compressed

* Müller, Arch. f. Gynæk., Bd. v. 1873, p. 132.

† Schatz, Arch. f. Gynæk., Bd. ii, 1871, p. 297.

‡ Dohrn, Arch. f. Gynæk., Bd. x, 1876, p. 544; I. E. Taylor, Atresia of the Vagina, Trans. of the Am. Gynæc. Soc., vol. ix, 1880, pp. 9, 12.

I. E. Taylor, *loc. cit.*, p. 16.

‖ Trans. of the New York Obstet. Soc., vol. i, p. 44.

^ Braun von Fernwald, Lehrbuch der gesammt. Gynæk., p. 273.

sponges, the tampon of slippery-elm (Skene), or the water-bag. When dilatation is already well advanced, incisions may be used to aid in completing the process.

Uterine Tumors complicating Pregnancy, Parturition, and the Puerperal State.

I. **Uterine Myomata.**—1. *In Pregnancy.*—Because of the disposition of uterine myomata to produce sterility, they naturally constitute comparatively infrequent complications of pregnancy. They are subdivided, according to their location, into subperitoneal, interstitial, and submucous myomata. The presence of either variety diminishes the probability of conception, but none absolutely precludes the possibility of its occurrence. In most instances, myomata produce no symptoms during pregnancy, and do not disturb labor.

Subperitoneal myomata prevent conception and interrupt uterogestation only when they attain large dimensions, and their prejudicial influence is then usually referable to the uterine retroversions or retroflexions which they induce. Interstitial myomata are more likely than the preceding variety to occasion abortion or premature delivery, either by producing uterine flexions, or by acting as the exciting cause of hæmorrhages, which are more severe when the placenta is located over the site of the tumor. This statement applies particularly to *post-partum* hæmorrhages, inasmuch as the muscular atrophy induced by the moyma prevents the ready and complete closure of the uterine sinuses.

Submucous myomata rarely permit of conception, which, in the event of its occurrence, is almost uniformly followed by abortion, due usually to metrorrhagia. In cervical myomata, however, pregnancy may progress to its normal termination. Myomata ordinarily participate in the uterine hypertrophy of pregnancy, becoming at the same time softer and more succulent. This change in consistence, which is referred to increased vascularity, to colloid transformation, and to serous infiltration, is attended by dilatation of the lymphatics, which may lead to the formation of cysts. The softened tumor readily undergoes changes of form under the influence of increasing intrapelvic pressure and of uterine traction. It may become so flattened that it ceases to be recognizable as a tumor, but regains its earlier shape after delivery.

The diagnosis of uterine myomata, particularly of the interstitial and submucous varieties, is often attended during pregnancy by difficulty, inasmuch as their symptoms and signs are obscured by those of pregnancy. On the other hand, the existence of myomata may prevent the recognition of pregnancy. Fibrous tumors may be mistaken for fetal organs or for intra-uterine cystic tumors. Careful palpation by the combined method with two fingers in the vagina, or the half or entire hand in the rectum if necessary, should be employed to make out the shape, position, and consistency of the suspected growth. As

a further aid to diagnosis, Landau recommends puncture through the vagina, by means of which the presence or absence of fluid and the density of the tissues penetrated can be determined.

2. *In Parturition and the Puerperal State.*—Uterine polypi act as impediments to delivery only when they are situated beside or in front of the advancing child, and are possessed of considerable size and consistence. If the tumor be small, movable, and yielding, it may occasion trifling obstruction to parturition, and may even be expelled by the advancing fœtus, after rupture of its pedicle.

Interstitial myomata, when corporeal, constitute impediments to delivery only when located in the lower segments of the uterus. Even when thus situated, they often spontaneously recede from the pelvic cavity under the influence of the longitudinal uterine contractions. By exerting traction on the uterine parietes they aggravate the severity of the pains, and sometimes produce rupture of the uterine wall, in which their growth has already determined atrophic degeneration. By interfering with symmetrical uterine contraction, interstitial myomata render the pains irregular and inefficient, besides predisposing to *ante-* and particularly to *post-partum* hæmorrhage. By altering the form of the uterine cavity and preventing the engagement of the head in the superior strait, this variety of myoma frequently produces abnormal positions and presentations. In a case of my own eclampsia resulted apparently from the same set of causes as those which obtain in multiple pregnancy. They also predispose to the development of retroflexions in the puerperal state. When interstitial myomata are developed in the cervical tissues they almost invariably offer a mechanical impediment to delivery, and are rarely capable of being displaced above the superior strait. If, however, they have become intravaginal and their base be not too extensive, they are often readily amenable to appropriate surgical interference. In default of the latter, fatal compression may be exerted upon the fetal cranium, or the vesico-vaginal septum may be lacerated during labor.

Subserous myomata are ordinarily developed in the posterior uterine wall. If connected with the body of the uterus and located above the retro-uterine reflexion of the peritonæum, they may be spontaneously extruded from the pelvic into the peritoneal cavity. They originate, however, most frequently in the cervical tissues, and, extending downward, become retrovaginal, more or less completely occupy the pelvic cavity, and offer, provided their size be at all considerable, an insurmountable obstacle to parturition. This variety has been designated as the incarcerated uterine myoma. The prognosis is grave, a fatal termination having been noted in one half of the mothers and in two thirds of the children.

Treatment.—Myomata in most cases, it should be remembered, produce no symptoms during pregnancy, and do not disturb labor. If

of small size, they may escape observation altogether. Their mere presence, therefore, does not indicate ground for interference. As a rule, it is well to observe a waiting policy until the need of assistance becomes evident.

The induction of abortion where the tumor threatens to disturb the later progress of pregnancy is a questionable expedient on account of the tendency to profuse hæmorrhage, and the difficulty of removing the secundines. Dr. A. Kessler reported a case, which I saw with him in consultation, where, after the expulsion of a four months' fœtus, it was found impossible to reach the placenta. The latter occupied an inaccessible position near the right cornu, far out of reach of the hand, while the convexity of the tumor was so great as to interfere with the working of ovum forceps or the curette. The patient died of septicæmia. Removal of the uterus would possibly have saved her life.

Kaltenbach has reported a case where he performed the supravaginal amputation of the uterus between the fourth and fifth months of pregnancy, on account of myomata, the largest of which weighed seven pounds. They gave rise to unendurable pressure and to exhausting hæmorrhages. The patient recovered.

T. Landau * has collected eighteen cases in which amputation of the pregnant uterus has been performed, owing to disturbances produced by myomata. Of these, eleven recovered and seven ended fatally.

If the myomata are pedicled or subserous and of moderate size, their removal during pregnancy by enucleation is justifiable if they threaten complications. The prognosis is not unfavorable, for though in seventeen operations collected by Landau four patients died, one of these had a large, broad-based multiple tumor, one suffered from nephritis, and two occurred in the days of defective asepsis. In two of the fatal cases, and in four where recovery took place, abortion followed. If myomata encroach upon or occupy the pelvic cavity, an attempt should be made to raise them above the brim by sustained rectal or vaginal pressure.

The most serious obstruction to the birth of the child is offered by cervical and subserous myomata which encroach upon the pelvic space. They are of rare occurrence. The treatment varies according to the intra or extravaginal situation of the growth. In both instances, where the child is living, operative interference should be postponed if possible to end of pregnancy.

In the intravaginal form, room should be made for the exit of the child by splitting the capsule and enucleating the myoma. Bleeding from vessels should be controlled by compression forceps, and the cavity should be filled, after the expulsion of the child, with iodoform gauze. Even tumors of large size may be enucleated *per vaginam* if

* T. Landau, Zur Behandlung der durch Myome Complicirten Schwangerschaft und Geburt. Klin. Vorträge, Neue Folge, No. 26.

they are first segmented ("*morcellement*" of Péan), and are then removed piecemeal.

Dr. P. F. Mundé * has reported a case of pregnancy advanced to the sixth month where an interstitial myoma of the anterior wall of the uterus and of the cervix filled the pelvic cavity almost to the vaginal orifice. After careful deliberation, Mundé decided to remove the tumor by enucleation. This he accomplished successfully; the tumor weighed three pounds. The fœtus and placenta were then easily extracted. The mother made a good recovery. Similar successes have been reported by Schroeder, Grimsdale, Danyon, and Braxton Hicks. Depaul enucleated the morbid growth in the case of fibrous polypus, with a broad attachment (six to seven centimetres) to the cervix. The patient died two months later, but the tumor gave forth an extremely offensive odor at the time of the operation.

With small tumors it may be possible to extract the child first with forceps or version, or after craniotomy. Chambazian reports twenty forceps cases, in which twelve mothers and seven children were saved. Of twenty version cases, only eight mothers and three children survived. But even then it is usually prudent to remove the tumor immediately after the birth of the child, owing to the danger of septic infection incident to the bruising of the tissues. Then, on checking the hæmorrhage, the cavity should be filled with iodoform gauze.

Polypoid growths should be pushed back into the uterus, if possible, in cases where the pedicle is out of reach. When, however, the tumor is shoved down in advance of the head, and the pedicle is accessible, it should be removed with the *écraseur* or with scissors. Chambazian † reports eight cases of extirpation performed during pregnancy, on account of hæmorrhage, with one death, due not, however to the operation, but to eclampsia. In eight cases of removal during labor there was no death.

In pelvic obstruction due to extravaginal myomata the growth is usually of cervical origin. As a rule, it develops in the pelvic connective tissue behind the uterus, and is only roofed over by the peritonæum. As the Cæsarean section or the Porro operation is indicated in these cases of impaction, it is desirable, unless the symptoms due to pressure are urgent, that interference should be postponed to the end of pregnancy.

Sänger ‡ collected forty-three cases of Cæsarean section complicated by myomata. Of these, in thirty operations performed previous to 1874 but two recoveries were reported. Since 1874 there have been thirteen operations, with five recoveries. Of these, in three cases—viz., in Tarnier's, Zweifel's, and Agnew's—the Porro method was followed, and all

* Mundé, Am. Jour. Obstet., October, 1884, p. 1,061.

† Chambazian, Des fibromes du col de l'uterus, Paris, 1882.

‡ Sänger, Der Kaiserschnitt bei Uterus-Fibromen.

terminated fatally. Of the ten cases in which the older method was adopted, in five—viz., in those of Cazin, Cornelius Olcott, Martin, Sänger, and Moses Baker—the patients recovered. In four of the five fatal cases, the particulars are furnished in four. In that of Netzel, the membranes ruptured three days before the operation; in McCormack's, the patient had been fifteen days in labor, and general peritonitis existed; in T. G. Thomas's, the membranes had ruptured, and, previous to operating, unsuccessful attempts at delivery had been made by means of version, craniotomy, and embryotomy; in Spiegelberg's, no contraction followed the section, and the patient died from exhaustion due to hæmorrhage.

Since the appearance of Sänger's memorable work, of seven cases where his method was employed in consequence of myomata, only that of Leopold recovered. In the cases which terminated fatally the patients were, however, all in a septic condition at the time of the operation. Still, owing to the excessive vascularity, the imperfect contractility, and the hindrances to drainage in myomatous uteri, the conditions at present favor a resort to the Porro method. Successes have been reported by Schroeder, Hofmeier, von Ott, and L. Landau, in cases where the extraction of the child was followed by the removal of the uterus. In each the intro-abdominal method was employed in the treatment of the stump.

Landau's case was especially instructive. The abdominal incision extended from the symphysis to a hand-breadth above the navel. The uterus was turned out, and after the adjustment of a rubber ligature the child was removed alive by the uterine incision. In bringing the uterus forward the retro-uterine and retro-cervical tumor was dragged out of the pelvic cellular tissue in which it was imbedded. The elastic ligature was placed below the entire uterus, the ovaries, and the tumor, the uterus was severed, and the tumor was enucleated. The raw surfaces of the stump were first united by eight deep sutures, which likewise included the bed of the tumor, and then the peritonæum was drawn from the sides to cover the wound. In this case it was thought best to employ drainage through Douglas's *cul-de-sac* by means of iodoform gauze, owing to the enormous serous transudation of the tissues. The gauze was changed at the end of forty-eight hours, and on the fourth and sixth days. On the seventh day the wound was allowed to heal. The patient left the hospital after three and a half weeks. The child weighed seven pounds at its birth, and throve afterward. (Klinische Vorträge, N. F., No. 26.)

Ott, after removing uterus and ovaries, left the retro-uterine tumor *in situ*. The wound was closed by a triple-stage suture. As a consequence of the removal of the ovaries, the myoma rapidly shrank to small dimensions. (Arch. f. Gynaek., Bd. xxxvii, p. 88.)

II. **Carcinoma of the Cervix Uteri.**—1. *In Pregnancy.*—Uterine cancer, which is one of the gravest complications of pregnancy, is, if primary, almost without exception of cervical origin. Conception often occurs in the earlier stages of the disease, and since it is only

absolutely prevented by a carcinoma which completely occludes the cervical canal, it occasionally takes place even in the later stages of the neoplasm's growth. The existence of pregnancy usually hastens the development of the cancer, the more rapid growth of which is probably referable to the increased vascularity of the uterus and to the correspondingly augmented activity of its nutritive processes. In rare instances the occurrence of pregnancy seems to arrest the development of the local and general symptoms referable to the cancerous growth. In the majority of cases the neoplasm does not interfere with the completion of normal utero-gestation, although abortion or premature delivery is a frequent result of its development. These issues of pregnancy are most frequently determined by cancerous tumors whose progress has invaded the higher, supravaginal portions of the cervix, and is probably occasioned by the interference, on the part of the neoplasm, with the normal process of uterine growth and expansion. The traction exerted by the enlarging cervix upon the unyielding tissues of the tumor may also produce a solution of their continuity, and give rise to formidable hæmorrhage. In very exceptional cases uterine carcinoma seems to protract the period of gestation far beyond its normal limits, in which case the fœtus dies and undergoes the changes usual in retention.

2. *In Parturition and the Puerperal State.*—If the cancer be confined to the lower margin of the cervical canal, the expansion of the latter is not materially interfered with, and delivery may be safely and speedily accomplished. If, however, the morbid process has involved the entire portio vaginalis, or has even extended quite to the os internum, the inelastic tissue of the cancerous growth has replaced the expansile muscular fibers, and an opening of sufficient caliber for the passage of the fœtus can only be produced by rupture and contusion of the degenerated and unyielding cervix. The immediate result of such a laceration is violent hæmorrhage, which is, however, quite amenable to treatment. The consequence of the excessive pressure to which the cervix is subjected during labor is necrosis of the contused tissues, which is frequently followed by fatal septicæmia.

The diagnosis is accomplished by the same means which are employed in the detection of cervical cancer in the unimpregnated condition.

The prognosis is doubtful for both mother and child. The latter is imperiled by its liability to premature expulsion, and by the mechanical obstruction to its birth produced by the tumor. The mother's life is not only shortened by the rapidity of the cancerous growth usually induced by pregnancy, but is jeopardized by her increased liability to abortion, *post-partum* hæmorrhage, and puerperal fever.

Treatment.—During pregnancy, in cases where the disease is confined to the cervical portion, either amputation or excision should be

performed. The time selected for operation is usually the fourth month. Abortion does not necessarily follow. In advanced stages, where the carcinomatous process has invaded the contiguous tissues, operative interference should be postponed until the end of gestation. Just in proportion as the outlook for the mother grows questionable, the interests of the child rise in importance. An extensive removal of diseased tissue during pregnancy exposes the mother to the immediate dangers of premature labor and subsequent septicæmia. Upon the advent of labor, if the child be living, and the upper vaginal tissues are largely involved, the Cæsarean section or the Porro operation certainly holds out the hope of saving one life, and probably does not greatly increase the peril to which the other is exposed.* Dr. Fordyce Barker stated that he met with three cases of spontaneous delivery where the cervix was carcinomatous, in all of which the mother survived the childbed period. Such good fortune, however, is necessarily rare, and is only likely to result in patients whose tissues are but moderately affected. Frommel † reports a case from the Berlin Clinic where, the child being dead, Schroeder broke away with his hands large masses of the neoplasm, and thus provided a passage of sufficient size to permit the extraction of the child by version. The patient was discharged on the tenth day, but died a few days after. Alfred Gönner ‡ recommends that labor be allowed to proceed until dangerous symptoms call for active measures, or the limit of physiological dilatation is reached. Then, if the vagina is not too extensively implicated, by means of incisions and the partial extirpation of the diseased mass with the galvano-caustic wire, the thermo-cautery, and volsella forceps, room should be made for the extraction of the child by forceps, or after version. Of four cases thus treated, the mothers all recovered from the immediate effects of the operation, and three of the children were born living.

III. **Ovarian Tumors.**—1. *In Pregnancy.*—Ovarian tumors, particularly those of the cystic variety, are quite often encountered as complications of pregnancy. They usually antedate conception, but may make their appearance during pregnancy. Utero-gestation often favors their development by increasing the general vascularity of the pelvic viscera, although an arrest of growth and an actual retrogressive metamorphosis of the tumor seem to be the occasional effect of

* Herman (Trans. of the Obstet. Soc. of London, vol. xx, p. 191) reports twelve Cæsarean operations, with four recoveries. In a case reported by the author in 1887, the patient lived two months after the Cæsarean section, and then succumbed to the ravages of the cancerous affection. The child has thriven up to date—1881. Leopold has performed the Porro operation twice for carcinoma with success.

† Frommel, Zur operat. Therapie d. Cervix-Carcinoms in d. Complication mit Gravidität, Ztschr. f. Geburtsh. und Gynaek., Bd. v, p. 158.

‡ Gönner, Zur Therapie der durch Carcinom des Uterus complicirten Schwangerschaft und Geburt, Ztschr. f. Geburtsh. und Gynaek., vol. x, p. 7.

intercurrent conception.* This retrogressive process affects only cystic tumors, and may result from the uterine pressure, which facilitates the absorption of their contents. After delivery the cysts present on palpation a relaxed and flabby condition. The natural tension of the tumor is soon restored by the secretion of additional fluid, except in those rare cases in which the compression of the gravid uterus seems to initiate a permanent process of retrogression and absorption.

Wernich † advanced the opinion that the assumption by benign ovarian tumors of a malignant character is determined by the occurrence of pregnancy, and Spiegelberg ‡ regards this transition as positively established. The ovarian tumors under consideration may be bilateral. If they be of moderate dimensions, they may not interfere with utero-gestation or delivery, except by a slight aggravation of the usual disturbances attendant upon pregnancy. An ovarian tumor is, however, liable to occasion abortion or premature delivery if it be confined by adhesions to the pelvic cavity, or be closely connected to the uterus. Under these circumstances, abortion results from interference on the part of the new growth with the natural uterine expansion, or from the retroflexion which it induces. In rare instances a rotation of the cyst upon its axis, followed by strangulation of its pedicle, is observed. This deplorable accident leads to a lethal issue by shock, by gangrene of the cyst and consequent septicæmia, or by hæmorrhage into the tumor and the peritoneal cavity, followed by peritonitis. The rationale of the morbid phenomena referable to tumors of larger size is entirely different. These tumors do not often occasion abortion or premature delivery, but gravely complicate the later periods of pregnancy by means of the pressure which they, in common with the gravid uterus, exert upon the abdominal and thoracic viscera. Ascites and dyspnœa are the chief results of the augmented intra-abdominal tension. Œdema of the lower extremities is often observed. The ovarian cyst sometimes ruptures and produces fatal collapse, peritonitis, or septicæmia. The escaped cystic fluid may, however, be absorbed, and pregnancy reach a natural termination.

Diagnosis.—If the ovarian tumor be of small size, it may be completely masked by the growing uterus, or may be mistaken for a portion of the latter. If, on the other hand, the surface of the tumor be irregular and nodular, the uterus may, at an early period of pregnancy, itself be regarded as a part of the cyst. Palpation and auscultation will, however, usually afford satisfactory diagnostic points of differentiation. Especially the softness of the pregnant uterus contrasts with the tense condition of an ovarian cyst. Moreover, the absence of the menses in patients with an ovarian tumor, and an unusually rapid in-

* Schroeder, Lehrbuch, p. 399.

† Wernich, Beitr. z. Geburtsh. u. Gyn., Bd. ii, p. 143.

‡ Spiegelberg, Lehrbuch, p. 297.

crease in the dimensions of the abdomen, should awaken the suspicion of combined pregnancy and ovarian tumor.

2. *In Parturition and the Puerperal State.*—The dangers resulting in parturition and the puerperal state from ovarian tumors complicating pregnancy are twofold, and consist (*a*) in the obstruction to labor which they occasion and (*b*) in the results of the morbid processes determined in the neoplasms themselves by the excessive pressure of the surrounding tissues.

(*a*) If the ovarian tumor is confined within the true pelvis in such a way as to render its spontaneous or manual displacement impossible, it may offer a most serious impediment to the expulsion of the fœtus. Dermoid cysts manifest a more decided tendency to contract adhesions in the pelvis than other ovarian tumors, and afford on this account, as well as because of the greater consistence of their contents, a worse prognosis than any other variety.* Obstructed labor more frequently results from the presence of small than from that of large ovarian tumors, since the latter oftener escape into the abdominal cavity during pregnancy, and are unable at any subsequent period to effect an entrance into the true pelvis.

(*b*) Even if the obstacle offered to parturition by an ovarian tumor be trivial, the changes induced in its own substance by the parturient act may be productive of very serious results. The pressure and traction exerted upon the pedicle of the cyst are often so severe as to produce its strangulation, followed by necrosis of the tumor, with consequent septic poisoning. Rupture of the sac, with its fatal consequences, may also occur, or such severe contusions of the tumor may be occasioned by excessive pressure as to result in gangrene of its entire mass. The development of the fœtus is, as a rule, not interfered with by ovarian tumors. The latter manifest a tendency to very rapid development in the puerperal state, except in those rare cases characterized by permanent retrogressive metamorphosis and absorption.

Ovarian tumors are a dangerous complication of pregnancy and labor. Jetter collected 215 cases with 64 deaths. Fortunately, however, the results of ovariotomy are as favorable in the pregnant as in the non-pregnant state. The operation does not necessarily interfere with the continuance of gestation. So soon as the existence of an ovarian tumor is recognized, therefore, in a pregnant woman, its immediate removal is indicated.† When the time is a matter of election the

* Schroeder, *op. cit.*, p. 501.

† Olshausen (Krankheiten der Ovarien) 1886, collected 82 operations performed by 44 operators. There were eight deaths, four of which took place before the days of antisepsis. Olshausen operated fourteen times. Four of the mothers aborted and two died. Schroeder (*Vide* Straty, Ztschr. für Geb. und Gynaek., vol. xii. p. 268) operated fourteen times. All the mothers recovered. Twelve of the children (including twins) went to term. Spencer Wells operated ten times. Nine women

operation should be performed early in pregnancy. In the later months the conditions are less favorable, owing to the excessive vascularity of the pelvic organs and the consequent development of the vessels in the pedicle. Pippingsköld, however, operated successfully upon a woman seven hours before the birth of a full-term child.

The alternative of ovariotomy consists in abiding the end of pregnancy, and then, when the tumor interferes with the birth of the child, in pushing it upward above the pelvis or, failing after repeated effort, in puncture of the cyst. The *cul-de-sac* of the vagina affords generally the most convenient point for the introduction of the trocar. The best time for tapping is during the existence of a pain, when the cyst is rendered tense by pressure.

CHAPTER XXIX.

ABNORMALITIES OF THE FŒTUS WHICH OFFER AN OBSTRUCTION TO DELIVERY.

Premature ossification of the cranium.—Hydrocephalus.—Encephalocele.—Hydrothorax.—Ascites.—Other causes of abdominal distention.—Tumors of the trunk.—Monstrosities.—Double monsters.—Acardiaci.—Anencephalous monsters.—Abnormal positions.—Spontaneous version.—Spontaneous evolution.

I. Fetal Diseases which obstruct the Expulsion of the Head.

Premature Ossification of the Fetal Cranium.—This condition is characterized by the complete or nearly complete closure of the fontanelles. The head, therefore, loses its compressibility, and no longer undergoes those changes of form which constitute so important a part in the mechanical processes of delivery. As the anomaly is apt to interfere with brain development in infancy, the late Dr. John E. Blake* advocated early perforation where the interests of the mother had to be consulted. As I have never met with this form of dystocia in a large number of instrumental deliveries, I can not but regard it as extremely uncommon.

Hydrocephalus.—Congenital hydrocephalus of sufficiently marked development to constitute an impediment to parturition is comparatively rare, occurring, according to the statistics of Madame La Chapelle,† only fifteen times in 43,545 deliveries. It consists usually in a serous effusion confined to the cerebral ventricles. The effusion may,

recovered and went to term. A. Martin reports three ovariotomies. The mothers recovered. Pregnancy was not interrupted.

* Blake, Am. Jour. of Obstet., vol. ii, 1879, p. 225.

† Spiegelberg, Lehrbuch, p. 525.

however, according to Jaccoud and Hallopean,* be situated in the meshes of the pia mater, in the cerebral parenchyma, in the subarachnoid cavity, or between the arachnoid and the dura mater.

Etiology.—The etiological factors of the disease have not been ascertained, although Herrgott † assumes an invariable causative relation between coexisting cretinism and hydrocephalus.

Morbid Anatomy.—The accumulated serum compresses the cerebral parenchyma and produces dilatation of the cranial cavity, which may become excessive. The cranial bones become abnormally thin, being in some instances no thicker than parchment. Their continuity may be interrupted by apertures of varying size, through which the contents of the cranium may protrude, constituting an encephalocele. The skull is of disproportionate magnitude as compared with the face. The head may attain the dimensions of that of an adult. The forehead is prominent and bulging, the sutures are widely open, and the fontanelles of large diameter. The body of the fœtus is usually well developed, and of a size corresponding to the existing period of pregnancy, although spina bifida and other malformations may coexist. Hydramnion frequently complicates hydrocephalus.

Diagnosis.—Cystic tumors, spina bifida, encephalocele, and the skull of a macerated fœtus, are most frequently mistaken for hydrocephalus. The differential diagnosis is based upon different signs, according to the position and presentation of the fœtus. If the head present and be still above the superior strait, abdominal palpation may sometimes detect a large, rounded, and hard tumor above the pubes, while auscultation discovers the maximum intensity of the fetal cardiac sounds above the umbilicus. The abdomen is unusually distended. If the head has descended somewhat into the pelvic cavity, palpation *per vaginam* reveals a fluctuating sac, which becomes notably tense during the pains. In the interval between the uterine contractions, the broad fontanelles, the thin bones, and the wide sutures are readily felt. These signs may, however, fail if the cranial bones be thick and the sutures already ossified. In this case the disproportion between the forehead and face, the bulging frontal bone, and the prominence of the superciliary ridges are important aids to a diagnosis. If the membranes be ruptured, the hairy scalp may be felt. The diagnosis is easier when the cranial cavity is not greatly distended. In case of a breech presentation, the diagnosis, which is then more difficult, must chiefly rest upon the detection, at the fundus, of a tumor larger than the normal fetal cranium. The previous occurrence of hydrocephalus in the same subject and feeble fetal movements may, in this instance, slightly facilitate the task of the diagnostician.

* Nouv. dict. de méd. et chir. prat., vol. xiii, article Encéphale, p. 151.

† Herrgott, Des mal fœtal. q. peuvent faire obstacle à l'accouch., Paris, 1878, p. 13.

Mechanism of Delivery.—The course of parturition is sometimes not materially impeded even by a largely developed hydrocephalic fœtus. This may be due, if the bones be attenuated, to the ready molding of the fetal cranium to the pelvis, or to rupture of the head and escape of the serum, which event occurs chiefly in breech presentations. The presentation materially affects the course of delivery. If the head be forced with its greatest circumference against the superior strait, it adapts itself less readily to the pelvis than when it impinges laterally or obliquely on the pelvic entrance. The difficulties of delivery are increased if the cranial bones be firm and thick, or the sutures ossified. Breech presentations are favorable to a speedy delivery, in that the head is subjected during its descent to more equable pressure by the pelvic parietes, and therefore assumes a conical shape best adapted to insure its easy expulsion. Spontaneous delivery is, however, rare. In the vast majority of cases operative interference becomes necessary.

Prognosis.—The child's life is usually sacrificed if the anomaly be sufficiently marked to considerably protract parturition. Even if the child be born alive, it will probably succumb at an early period of extra-uterine life. The prognosis with reference to the mother depends largely upon the time at which obstetrical aid is extended, and upon the nature of the remedial measures adopted. If the labor be too long protracted, vesico-vaginal fistula may result from pressure of the fetal head, or the mother may die from exhaustion or from rupture of the uterus. Rupture of the uterus is comparatively frequent, having occurred in sixteen out of seventy-four cases of hydrocephalus collected by Thomas Keith. The laceration usually occurs in the vicinity of the cervix, but is often located at the fundus uteri. The treatment consists in puncturing the head with a fine trocar and allowing the fluid to escape. If practicable, the child should be subsequently turned and extracted by the feet. The forceps is useless, as it can not be made to take a firm hold. If version is found to be attended with difficulty, the opening should be enlarged, and the head extracted with the cranioclast. If the child is extracted by the breech without previous perforation of the head, in cases of difficulty, Tarnier recommends section of the vertebral column and the withdrawal of the cranial fluid by means of an elastic catheter passed to the brain through the spinal canal.

Congenital Encephalocele.—This abnormality of the fetal cranium consists in the accumulation beneath the scalp of cephalic fluid, with or without an investment of meningeal or of cerebral tissue. The sac containing the fluid is attached to the cranium by a pedicle of varying length and form. The aperture through which the fluid originally contained within the cranium finds exit may be produced by attenuation of the cranial bones attendant upon hydrocephalus, or may be due to arrested development. In some instances the encephalocele is

found still communicating with the cranial cavity through its pedicle, but in others the latter is impervious. Encephaloceles vary in size from hardly perceptible sacs to tumors of larger circumference than the cranium itself. They may occupy any part of the periphery of the head, but are most frequent in the frontal and occipital regions.* The head may itself be hydrocephalic or normal. The cause of the anomaly in question is not definitely known, but is inferred to be of inflammatory nature.

Encephaloceles rarely obstruct delivery, because, their most frequent seat being in the frontal or occipital region, they are expelled either before or after the head. Their presence seems to determine nutritive changes in the cranial bones, whereby the latter, being rendered softer and more yielding, are more readily expelled. The amount of obstruction caused by the encephalocele will reach its maximum when the size is large, the pedicle short, and the seat lateral; but simple puncture usually suffices to evacuate the sac, and obviates further difficulty. The prognosis for both mother and child is far better than in cases of congenital hydrocephalus.

II. Abnormal Conditions of the Fœtus which obstruct the Expulsion of the Trunk.

Hydrothorax, unattended by serous effusion into any other of the closed cavities of the body, is infrequent, and when present is rarely of sufficient extent to offer any impediment to delivery. Spiegelberg encountered only one such case, and refers to but two others observed by Hohl.†

Ascites, although more frequent than hydrothorax, ordinarily constitutes an insignificant obstruction to parturition, on account of the yielding character of the abdominal walls and the small amount of fluid usually present. It has, however, in some instances markedly retarded delivery.‡

Ascites and hydrothorax are more frequently associated than isolated, and present, when combined, no inconsiderable obstruction to delivery. Pericardial effusions of varying magnitude may exist simultaneously with either or both of these affections.#

The size of the fetal abdomen may be so much augmented by distention or enlargement of its viscera as to obstruct labor. Among the causes of abdominal distention from this source may be cited:

(*a*) Cystic degeneration of the kidneys; ‖ (*b*) dilatation of the uri-

* Herrgott, *op cit.*, p. 121. † Spiegelberg, Lehrbuch, p. 528.

‡ Martin, Monatsschr. f. Geburtsk., Bd. xxvii, 1866, p. 28.

Herrgott, *op. cit.*, p. 155.

‖ Cummins, Dublin Jour. of Med. Sci., May, 1873, p. 499; Voss, Monatsschr. f. Geburtsk., Bd. xxvii, 1866, p. 28; Kanzow, *Ibid.*, Bd. xiii, 1859, p. 182; Wegscheider, *Ibid.*, Bd. xxvii, 1866, p. 27.

nary bladder;* (*c*) dilatation of the ureters;† (*d*) fibro-cystic degeneration of a testicle still retained in the abdomen;‡ (*e*) enlargement of the liver, due to degenerative processes;# (*f*) enlargement of the uterus, produced by secretions accumulated in its cavity, the cervix being impermeable;‖ (*g*) enlargement of the pancreas;^ (*h*) enlargement of the spleen;◊ (*i*) one fœtus included within another. In this case one fœtus is completely invested by the integument of the other, and is attached to the latter by a pedicle, which is usually inserted either in the sacro-coccygeal, perineal, or cervical regions.‡ A case of extensive anasarca of the fœtus, characterized by the peculiar gelatinous nature of the fluid contained in the subcutaneous cellular tissue, is reported by Keiller to have produced dystocia. Emphysema of the entire fetal trunk may result from putrefaction occurring in the tissues of a child retained for some time *in utero* after the escape of the amniotic fluid. The putrefactive processes owe their origin to the entrance of air within the uterus. The gaseous products of decomposition are developed in all the fetal tissues and in the cavities of its body. The skin is distended, translucent, and glistening. It crepitates on pressure, and gas escapes from incisions carried through the cuticle. The trunk and extremities are largely increased in volume, and their augmented size offers an obstacle to delivery which the uterine forces, probably already exhausted by prolonged expulsive efforts, can not overcome. In such cases the bulk of the child should be diminished by punctures of the skin to allow the gases to escape, and when the head presents it should be extracted with the cephalotribe. Tractions upon the extremities are liable to be followed by their separation from the trunk.

Tumors developed in different parts of the fetal trunk may disturb parturition. The most frequent site for these tumors is the sacral and perineal regions, where they are developed between the sacrum, the coccyx, and the rectum. Their size varies from that of a small walnut to that of the fetal cranium at term, and it may even exceed these dimensions. The tumors may be either cystic, fatty, vascular, cartilaginous, osseous, or carcinomatous. So-called cysto-hygromata are also frequently observed in this situation. Similar neoplasms may be located in the axilla, upon the pectoral muscles, and in the anterior or

* Whittaker, Am. Jour. of Obstet., vol. iii, 1871, p. 389; Duncan, Edinburgh Med. Jour., August, 1870, p. 163; Hartmann, Monatsschr. f. Geburtsk., Bd. xxvii, 1866, p. 273; Rose, *Ibid.*, Bd. xxv, 1865, p. 425; Olshausen, Arch. f. Gynæk., Bd. ii, p. 280; Kristaller, Monatsschr. f. Geburtsk., Bd. xxvii, 1866, p. 165; Hecker, *Ibid.*, Bd. xviii, 1861, p. 373.

† Ahlfeld, Arch. f. Gynæk., Bd. iv, p. 161.

‡ Rogers, Am. Jour. of Obstet., vol. ii, p. 626.

Schroeder, Lehrbuch, p. 634. ‖ Gervis, Obstet. Trans., vol. v, p. 284.

^ Martin, Monatsschr. f. Geburtsk., Bd. xxvii, 1866, p. 28.

◊ Voss, *op. cit.*, p. 26. ‡ Herrgott, *op cit.*, p. 266.

posterior cervical regions. Spina bifida, when accompanied by the formation of a large hydrorachitic sac, constitutes another form of congenital fetal tumor, and is most frequently observed in the lumbo-sacral region. Ectopia of the abdominal viscera, hernias, hydatid cysts, and encysted neoplasms of the abdominal walls sometimes constitute tumors sufficiently extensive to impede parturition. We may also cite anchylosis of the fetal joints, adhesions of the extremities to the trunk or to one another, and *rigor mortis*, as rare abnormalities which interfere with that pliability of the child requisite for its adaptation to the parturient canal, and finally, adhesion of the fœtus to the placenta or to the uterine parietes as causes of dystocia.*

Diagnosis.—An accurate differential diagnosis between these varied morbid conditions can, as a rule, only be made after delivery. If enlargement of the trunk be present, the head or breech is born without difficulty, but, the progress of parturition being then completely arrested, an investigation easily reveals the existence of an abnormally large trunk. A hydrorachitic sac is liable to be mistaken in a breech presentation for the fetal membranes. Its consistence is, however, not altered by the occurrence of uterine contractions, and no fetal parts are felt beneath the membrane, which is found to be continuous with the fetal cutaneous surface.

III. Monstrosities.

Dystocia is more frequently produced by double monstrosities than by any other variety. These are divided by Veit † into three principal classes, characterized, respectively, by—1. Incomplete double formation of the upper or of the lower extremities; 2. Two separate bodies united either by their upper or by their lower extremities; 3. Two separate bodies attached to each other either by their abdominal or by their dorsal surfaces.

Diagnosis.—The differential diagnosis of the individual deformities is usually impossible in the earlier stages of parturition. Even in the succeeding stages it is difficult, since separate twins may present essentially the same phenomena. The diagnostician will derive some assistance from the facts that certain women seem predisposed to the development of double monsters, and that certain smaller and easily recognizable deformities of the extremities (as club-foot) are often merely complications of more important ones, and serve to indicate the existence of the latter. The family history may furnish valuable assistance, inasmuch as the deformities under consideration are sometimes hereditary. Double monsters are most frequently observed in multiparæ; but this fact is referred by Veit ‡ to the relative numerical preponder-

* Whittaker, Am. Jour. of Obstet., vol. iii, 1871, p. 247.

† Veit, Volkmann's Samml. klin. Vortr., Volkmann, 1879, Nos. 164, 165.

‡ Veit, *op. cit.*, p. 1318.

ance of the former over primiparæ. When parturition has progressed sufficiently to allow of introduction of the hand within the uterus, should the necessities of the case call for this measure, the diagnosis becomes clear.

Mechanism of Labor.—The natural forces suffice, according to the statistics of Playfair and Hohl,* for the delivery of double monsters in more than fifty per cent of the cases. This fact may be attributed to the comparatively small dimensions of the fœtus and to the frequent occurrence of abortion or of premature delivery in cases of this nature. The course of parturition in a case of the first variety is similar to that obtaining when the head of a single fœtus is of unusually large dimensions. The second variety does not ordinarily seriously interfere with delivery, particularly if there be a breech presentation. In this case the bodies pass through the parturient canal simultaneously, lying parallel to each other. One head then passes along the hollow of the sacrum and is first expelled, while the other is retained above the brim, its neck being bent into close apposition to the pubes until after the expulsion of its fellow. Should there, however, be a disparity between the lengths of the necks, both the heads may simultaneously pass through the pelvic canal. When they reach the outlet, the head attached to the longer neck is expelled. The second head must then be expelled with the neck and shoulders of the former. Under these circumstances, interference on the part of the obstetrician is usually required.

Head presentations are the most common ones in cases of the third variety, and the course of parturition is as follows: The head of one fœtus is born, that of the other being detained above the pelvic brim. The trunk belonging to the first head then follows. Next comes the second trunk; and, finally, the head belonging to the latter. Spontaneous delivery, when it occurs, is usually effected in this manner. Head presentations of the first variety, i. e., those in which a single trunk possesses two heads, usually pursue the course just described.

Prognosis.—The prognosis for the child is very unfavorable, owing to its expulsion in an undeveloped condition and to the compression exerted upon it during labor. The prognosis for the mother is favorable because of the usual small dimensions of the fœtus and of the freedom with which measures for the reduction of its volume are resorted to in view of its probable early demise.

An **acardiacus** is a monster devoid of the heart. It is developed simultaneously with a normal fœtus, and is usually born after the latter. Its development, as already explained,† occurs in the following manner: The balance of circulation in the anastomosing vascular systems of twins contained in a single chorion (and therefore of the same sex) becomes disturbed, and the pressure in one system so preponder-

* Spiegelberg, Lehrbuch, p. 531. † Chapter on Multiple Pregnancy.

ates over that in the other that the circulation of the latter is reversed, and its hearts, lungs, and body atrophy. It now receives its nutritive supplies from the normal fœtus. As the result of congestion in its umbilical vein, its connective tissue often undergoes hypertrophy and œdematous infiltration. The same cause may result in hydrocephalus or in the development of a monster presently to be described as an

Fig. 220.—Author's case of acardia.

anencephalus. The most common variety of acardiacus is known as the acephalus, or headless monster. The amorphus is an acardiacus without head or extremities. It is of rounded form, and its surface, though ordinarily smooth, may present faintly marked tubercles, which are regarded as rudimentary extremities. The interior of the amorphus contains a rudimentary intestinal canal, cystic cavities, muscles, and vertebræ. The umbilical cord is attached indifferently to any

part of the body. The rarest form of the acardiacus is the acormus, or trunkless monster. It consists of an imperfectly developed head with a rudimentary trunk. Its umbilical cord is attached to the cervical region.

An **anencephalus** or **hemicephalus** is a monster with a well-developed trunk and a rudimentary head. The neck is short and the head rests directly upon the shoulders, which are so unusually broad as to constitute an impediment to delivery. The amount of amniotic fluid is ordinarily large. The face is turned upward and the eyes are prominent. The most common presentations for an anencephalus are the transverse and the breech. Sometimes the face or the exposed base of the skull presents. In such a case the diagnosis may be made by recognizing the sella turcica and other bony prominences of the base. Reflex actions may be produced by irritation of the medulla, as it rests exposed upon the basilar process of the occipital bone.* This deformity produces obstruction by permitting other extremities to enter the pelvic cavity simultaneously with the diminutive head, and by the unusual breadth of its shoulders. The latter are more readily expelled when the parturient canal has been previously dilated by the passage of the breech.

IV. Shortness of the Cord.†

Though dystocia from shortness of the cord is of rare occurrence, it should always be regarded as a possible source of delayed labor. Shortness of the cord may be absolute, as in cases where its length does not exceed a few inches; or a normal, or very long cord, may, by the formation of coils around the fœtus, become taut as the fœtus is expelled from the uterus.

In the preliminary stage of labor the effect of shortness of the cord is sometimes perceptible in the irregular heart-action of the fœtus, in the recession of the head not due to the resistance of the soft parts during the intervals between the pains, and in an interference with the mechanism of labor as characteristic of an early period. In the second stage the effects of the shortening may be experienced at the pelvic outlet. Usually, however, difficulty is not encountered until after the expulsion of the head.

As the result of the tension to which the cord is subjected, it stretches, and, as Duncan points out, some gain in distance from child to placenta is obtained by the drawing out of the two insertions, the navel and abdominal wall on the one hand, and the placenta and uterine wall on the other; or, if the cord encircles the child, length may be gained by compression of the encircled parts. Stretching alone

* Herrgott, *op. cit.*, p. 263.

† Matthews Duncan, Obstruction owing to Shortness of the Cord, Obstet. Trans., 1881, p. 243; Chautreuil, Des dispositions des cordons, Paris, 1875.

may permit natural birth to take place. If not, the continued tension may result in the tearing of the cord, in partial inversion of the uterus, or in the separation of the placenta. According to Duncan, the cord yields to a strain equal to five and a half pounds for the weakest, and fifteen pounds for the strongest.

When the cord becomes taut during the expulsion of the fœtus, the anterior surface of the latter rotates forward so as partially to undo the encircling and diminish the tension. In the completion of the birth the cord lies close to the urethra, and forms a radius around which the body revolves, a movement which Duncan aptly compares to spontaneous evolution in shoulder presentations.

Under these several conditions the fetal mortality is said to be upward of twenty per cent. That of the mother is much less serious. Aside from hæmorrhages due to placental detachment, and rare instances of uterine inversion, the most important consequences are those which result from delayed labor. I have witnessed the following case, which terminated fatally: The patient was a primipara, twenty-two years of age, who, after five days of ineffectual labor, entered the Emergency Hospital. Her temperature was 103·5° Fahr. She was in great agony. The external genital organs were inflamed. The fetal heart had ceased to beat, and meconium escaped from the vagina. The head could be seen through the gaping vulva. After giving ether, I applied forceps, but met with more resistance than I had anticipated. After extracting the head, on passing up the finger I found the cord tense, and coiled a number of times around the child's neck. When about to sever the cord, a sudden pain was followed by the expulsion of child, cord, and placenta together. The next day the external genitals became gangrenous, and on the fifth day the patient died from a slough in the upper portion of the vagina, which communicated with the peritoneal cavity, and had evidently been the result of the long-continued pressure.

A positive diagnosis can only be made when the labor has so far advanced that the cord can be felt with the finger. The treatment consists in loosening the coils, where it is possible, or in severing the cord, if accessible, and speedily extracting the infant. During expulsion the rotation of the child forward may be aided, and assistance may be rendered, by external pressure downward upon the fundus of the uterus.

V. Transverse Presentations.

In so-called transverse presentations the axis of the child crosses obliquely the axis of the uterus. A horizontal position of the fœtus, with both extremities occupying nearly the same level, is the rare exception. Usually the child lies obliquely with the head resting upon an iliac fossa. When the uterus contracts, the shoulder is usually

pressed down into the lower uterine segment; hence shoulder and transverse presentations are frequently employed as synonymous expressions. In shoulder presentations prolapse of the lower arm or of the cord are not of infrequent occurrence.

The position of the child with the head to the left, as the more frequent one, is termed the first position; with the head to the right, the second position. According as the back of the child is directed forward or to the rear, we further distinguish dorso-anterior and dorso-posterior positions. The dorso-anterior position is the usual one.

According to Churchill's statistics, the frequency of transverse presentations is 1:252, Spiegelberg found it 1:180, while in France the combined statistics of Depaul, Dubois, and Pinard show a frequency of 1:117 (Charpentier).

The causes of this abnormality are to be found in the absence of the conditions which contribute to the fixation of the cephalic extremity. Thus a predisposition is created by an excess of amniotic fluid, by placenta prævia, by multiparity, by premature births, by death of the fœtus, and by uterine and pelvic deformities.

Diagnosis.—The existence of a transverse presentation can usually be ascertained by means of external palpation. Thus, the hard, round head can be mapped out in most cases in an iliac fossa, and the soft breech of smaller size be felt at a higher level upon the opposite side. Upon vaginal examination, the presenting part is commonly felt high up at the level of the brim, so that it is sometimes necessary to introduce the half or even the entire hand to arrive at certainty in diagnosis. Great care should be exercised in passing the finger through the cervix for purposes of exploration, as it is especially desirable to avoid premature rupture of the membranes. In an early stage of labor the vaginal vault is flattened. With the advance of the first stage the shape of the bag of waters corresponds to the resistance offered by the cervical canal. In multiparæ, and in all cases where softening and dilatation proceed rapidly, the ordinary globular segment may form in advance of the presenting part; if the cervix remains rigid, the membranes usually make their way through the cervical canal as an elongated pouch, a condition which especially favors the early occurrence of rupture. Sometimes the diagnosis is made clear by the presence of a prolapsed extremity in the bag of waters. After rupture of the membranes, the shoulder is recognized by feeling the scapula with its spine, the arm-pit, the clavicle, and the ribs, and, in many cases, by means of a prolapsed upper extremity.

The position is determined by the direction of the head and of the back. Often these can be made out by external palpation alone; by vaginal examination, the relations of the scapula and clavicle to the uterine walls, and the direction of the arm-pit, furnish the data for the formation of the diagnosis. If the arm is prolapsed, it may be drawn

outside the vulva. If the hand then be turned with the palm upward, the arm is always of the same name as the side of the mother to which the thumb is turned. If the presenting arm and the direction of the head be known, the position of the back, whether to the front or rear, is readily deduced.

Spontaneous Version.

The term *spontaneous version* is applied to the process by which either a transverse position is transformed through Nature's unaided efforts into a longitudinal one, or to that by which a normal position is either partially or completely reversed. Spontaneous version, which occurs during pregnancy as a very frequent physiological phenomenon, is observed with comparative infrequency during labor. It may be partial or complete, according as the presenting member is displaced laterally through either 90° or 180°, may occur before or after the rupture of the membranes, and may result in the transformation of a transverse position into either a head, a breech, or a footling presentation. According to the statistics of Hausemann,* cases of spontaneous version after rupture of the membranes are nearly five times as frequent as those occurring before their rupture. The same author states that the head presented in eighty per cent of the cases occurring before rupture of the membranes, and the breech in seventy-five per cent of those taking place after the occurrence of that event. Spiegelberg † cites two cases from his own practice in which there was an escape of so-called "false waters," the real membranes remaining intact, and attributes the occurrence of spontaneous version in such instances to the change of uterine form rendered possible by the evacuation of the false waters.

Etiology.—Among the conditions predisposing to spontaneous version is the uterine atony incident to repeated deliveries. About two thirds of all the women in whom spontaneous version occurs are, accordingly, multiparæ,‡ and their average age is thirty years. Spontaneous version often recurs during several consecutive pregnancies of the same individual. It is more apt to occur during deliveries effected at term than in abortions or premature deliveries. A living fœtus is more frequently the subject of spontaneous version than a dead one, and many authors attribute an important agency in the production of the altered position to the active movements of the child. The uterine contractions are necessarily weak in cases of spontaneous version occurring before the rupture of the membranes, as powerful pains would force the presenting part still farther into the dilated os and fix it immovably in the pelvic brim. On the other hand, the contractions of the uterus during a spontaneous version which takes place after the

* Hausemann, Monatsschr. f. Geburtsk., Bd. xxiii, 1864, p. 366.

† Spiegelberg, Lehrbuch, p. 539. ‡ Hausemann, *loc. cit.*, p. 212.

escape of the amniotic fluid must be strong, as will be explained in our remarks on the mechanism of the process in question. An undilated cervix, powerful contractions of the uterine fibers, and a fully developed child are essential conditions for the occurrence of spontaneous version after rupture of the membranes. Some authors consider the presence of a certain amount of amniotic fluid indispensable to the occurrence of spontaneous version in those cases taking place after rupture of the membranes. It is also necessary in such instances that the shoulder or other presenting part be freely movable, not having yet been firmly fixed in the cervical or pelvic canal.

Mechanism of Partial Version.

1. *Before Rupture of the Membranes.*—In this case the shoulder usually presents, the head being lower than the breech. The os is only partly dilated. The woman having assumed a position upon that side of her body toward which the head is directed, the breech tends to descend under the influence of gravitation, while the head is thus approximated to the cervix. The contractions of the uterine muscular fibers now complete the version by exerting pressure upon the breech. When the uterus has once regained its natural shape, the normal position is retained by the fœtus until the completion of parturition. In other instances, the breech being lower than the head, the same mechanism leads to a breech or to a footling presentation.

2. *After Rupture of the Membranes.*—In this variety of spontaneous version the amniotic fluid has partially or entirely escaped, allowing the fœtus to be tightly grasped by the uterine muscular walls, which, therefore, labor under a mechanical disadvantage. The os is only partially dilated. The pains force the presenting part into close contact with the os internum. Owing to the absence of an equally distending bag of waters, the os does not dilate, and soon assumes a condition of tetanic spasm, during which it can be felt as an unyielding, cartilaginous ring. The contractions of the fibers at the fundus uteri having now become more forcible, the fetal head or breech, as the case may be, is subjected to violent pressure. Inasmuch, however, as the unyielding os prevents any progress downward, the presenting part is displaced laterally, and that part of the fœtus which previously occupied the fundus is forced into the pelvic entrance. The uterus next regains its natural form, the os dilates, and delivery is accomplished.

Mechanism of Complete Version.

Cases of complete version, which are very rare, consist in the transformation of one normal longitudinal presentation into the diametrically opposite one, the part originally presenting having rotated through 180°. The mechanism is essentially identical with that just described.

Version of this variety is only likely to occur when the amount of liquor amnii is large and the child small, so that it is freely movable. Spontaneous version before the rupture of the membranes occupies only half the time required for its accomplishment after their rupture. Twenty-four or thirty hours are often necessary for the completion of the latter variety. Delivery, too, is accomplished more speedily in cases of the former kind when version has once occurred.

Prognosis.—The prognosis for both mother and child is good in spontaneous version before rupture of the membranes, but is graver when the turning occurs after that event, contrasting unfavorably with manual version, owing to the fact that injurious pressure is liable to be exerted upon the prolapsed cord.

Labor when the Presentation remains Transverse.

If the transverse presentation continues after rupture of the membranes, the entire contents of the amniotic sac escapes, and the uterine walls retract down closely upon the fœtus, or the shoulder is pressed into the pelvic cavity, the contraction-ring recedes, and the back of the child is forced into the cervix and the thinned lower uterine segment. In the latter case danger of rupture becomes imminent. Usually, if the malposition of the child is not corrected by art, or rupture does not occur, the rigid uterine walls closely compress the fœtus, and the mother in the end dies from the ensuing exhaustion, or from metritis, from peritonitis, or from septicæmia. In rare cases, however, spontaneous birth of the child may take place by the process termed evolution.

Spontaneous evolution is the process by which a shoulder presentation is transformed, within the true pelvis, into a combined breech and shoulder presentation, and spontaneous delivery is then effected. Since this may be accomplished in two different ways, there are two corresponding varieties of spontaneous evolution. The first variety was, according to Leishman,* described by Douglas, of Dublin, as "spontaneous expulsion." Dr. Taylor † takes exception to Leishman's statement, and affirms that the term spontaneous evolution was applied by Douglas to the mode of delivery in question. The second was described by Röderer as "birth with double body" ("*evolutio conduplicato corpore*"), and more thoroughly explained by Kleinwächter.‡

Etiology.—Various conditions contribute to the facility with which this process is accomplished by Nature. The most important are powerful pains, a roomy pelvis, and a small fœtus. Of these conditions, the first only is essential; Grenser # has demonstrated that a

* Leishman, A System of Midwifery, Philadelphia, 1873, p. 337.

† Taylor, Am. Jour. of Obstet., July, 1881,

‡ Kleinwächter, Arch. f. Gynaek., Bd. ii, p. 111.

Grenser, Monatsschr. f. Geburtsk., Bd. xxvii, 1866, p. 445.

contracted pelvis is not an insurmountable obstacle to spontaneous evolution, provided the conjugate diameter be alone shortened. Nor is small size of the fœtus essential to the occurrence of the process in question. Spiegelberg* states that it is often observed in cases where the fœtuses are mature and well developed. Softness and compressibility of the child naturally favor the production of spontaneous evolution, as is demonstrated by its frequent occurrence when the product of conception has undergone maceration.

Mechanism.—The mechanism of the former and more ordinary variety of spontaneous evolution is as follows: The presenting shoulder is forced into the depths of the true pelvis by the violence of the uterine contractions, instead of being diverted laterally, as is the case in spontaneous versions and becomes firmly fixed beneath the symphysis, while the corresponding arm protrudes through the vulva. The body

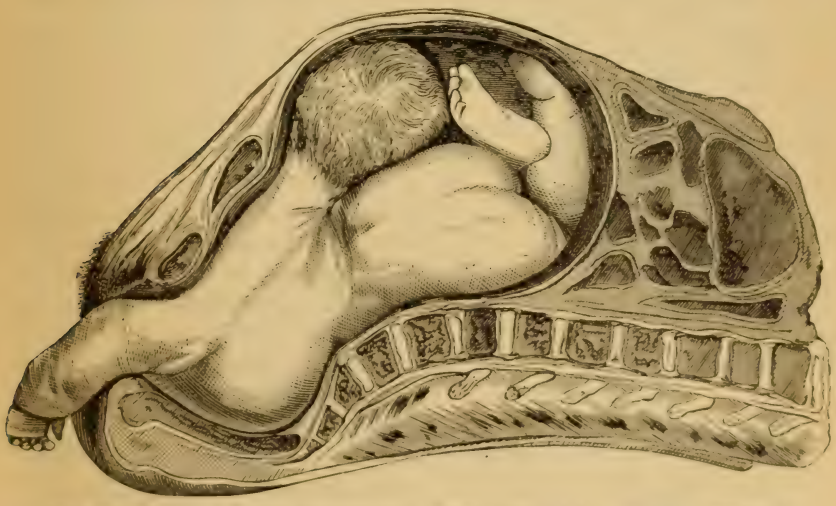


FIG. 221.—Neglected shoulder presentation. Section through frozen corpse. (Chiara.)

of the fœtus is then so forcibly flexed that the breech and the head lie in close proximity to each other. The former is in contact with the sacro-iliac synchondrosis, while the latter is immovably held between the breech and the upper border of the symphysis. The neck and shoulder, which rest against the lower border of the symphysis, now become the pivot upon which the fœtus rotates. The trunk of the fœtus is driven beyond the shoulder, and the thorax, breech, and legs are born in the order named. The other shoulder then follows, and the head is finally expelled.

The mechanism of the second variety of spontaneous evolution, designated by Röderer "*evolutio conduplicato corpore*," which is much

* SPIEGELBERG, Lehrbuch, p. 541.

rarer than the former, differs from it in some essential features. It is greatly facilitated by softness and compressibility of the child, and therefore occurs predominantly in cases of macerated fœtus. It is rarely observed in other cases, unless the fœtus be unusually small and its tissues greatly relaxed.

Fig. 222.—Birth with doubled body. (Kleinwächter.)

The shoulder is in this instance forced downward and imprisoned beneath the symphysis pubis, as in the former variety, while the arm protrudes from the vulva. The trunk having been enormously flexed, the head and thorax simultaneously enter the pelvic cavity, the former being deeply imbedded in the latter. The second arm and shoulder lie between the breech and thorax on the one hand, and the head on the other. The presenting shoulder having been expelled, the head and thorax are born together, and these are followed by the breech and the legs.

Prognosis. — The prognosis in spontaneous evolution is good for the mother, but very bad for the fœtus, since only immature children are, as a rule, able to pass through the ordeal of delivery by this method alive. Kuhn, however, has reported a case of a child born alive, weighing four and a half pounds and measuring seventeen inches in length; and Simon, according to Spiegelberg, collected one hundred and twenty-five cases in which fourteen children were born living. Three of the one hundred and twenty-five mothers died. In the variety of spontaneous evolution known as "*evolutio conduplicato corpore*," which occurs in the rule in small or macerated children, the prognosis is especially unfavorable. In these latter cases Dr. Taylor* recommends, when the perinæum is distended by the doubled body of the child, to make lateral incisions to the extent of three to four inches at the vulva, and thus remove the obstacle to delivery afforded by the pelvic floor.

* Taylor, Am. Jour. of Obstet., July, 1881, p. 532.

CHAPTER XXX.

ECLAMPSIA.

Definition.—Clinical history.—Prognosis, pathology, and etiology.—Treatment.

Eclampsia is the term applied to convulsions, tonic and clonic in character, the foundation of which is laid in processes connected with pregnancy, labor, and childbed (*eclampsia gravidarum, parturientium, vel puerperarum*). By this definition it is intended to exclude the convulsions due to hysteria, true epilepsy, and cerebral lesions, which occurrences in pregnancy are to be regarded simply as accidental complications. In eclampsia there is loss of consciousness during the attacks, with at first a disturbance of the intellectual faculties in the intervals, afterward deepening in severe cases into coma. Before entering upon a discussion as to the probable nature of this affection, it is proper to present a summary of its clinical manifestations.

Clinical History.—Eclampsia is fortunately a tolerably rare event. Its estimated frequency is in about the proportion of once in five hundred pregnancies. The total number of deaths from this cause reported to the Board of Health in New York city, in the nine years from 1867 to 1875 inclusive, was 408. The estimated maximum number of deliveries during that period was 284,000, or nearly one death to seven hundred confinements. The entire number of deaths occurring in pregnant women from all causes during the same period was 3,342, making the proportion of those from eclampsia as one to eight. In the majority of cases, though not invariably, premonitory symptoms announce the impending outbreak. Of these the most important are headache, often limited to one side, vertigo, loss of memory, gloomy forebodings, flashes of light before the eyes, contracted pupils, amblyopia, sometimes amaurosis, ringing in the ears, dyspepsia, nausea, vomiting, dyspnœa, œdema of the face, of the labia majora, and of the extremities, and, finally, and of first importance, the presence of albumen and of casts in the urine.

The attacks resemble those of epilepsy, the cry only lacking. When they occur during labor, the first convulsion often is preceded by a short calm, in which the patient ceases to complain, closes her eyes, and seems to have sunk into a peaceful slumber. This deceitful truce, which should always excite the keen attention of the physician, is followed in a few minutes by convulsive movements of the orbicularis oris muscle, giving to the patient a smiling aspect. Suddenly the eyelids open, the eyes become fixed, and the pupils contract. Then, in a few seconds, the eyelids open and shut rapidly, the eyes move from side to side or roll upward, while the pupils dilate and lose their sensitiveness to light. Very rapidly the convulsive twitchings extend to

the other muscles of the face, the mouth opens and is drawn to one side, the head is moved from shoulder to shoulder, sometimes with lightning-like alternations. Frequently, for the first two or three convulsions, the movements of the extremities are limited to the pronation and supination of the forearm and to the closing of the fingers upon the thumb. Afterward the arms, crossed upon the thorax, pass from flexion to extension with great rapidity. The movements, as a rule, are more pronounced in the upper than in the lower extremities. Sometimes the latter are fixed with tetanic rigidity, while at others they are flexed at the knee and then drop of their own weight, now upon one side, now upon the other.

As a consequence of the resulting disturbances in the circulation and respiration, the carotids pulsate with great distinctness, the superficial veins of the neck swell, the conjunctivæ become injected, and the face is cyanosed; the heart's action becomes intermittent, and the breathing irregular and stertorous.

In the tonic convulsions, which occur intercurrently with clonic ones, the head is inclined to one side, the mouth is drawn in the same direction, the jaws are closed, the eyes are fixed, opisthotonus or pleurosthotonus develops, the pulse becomes small and intermittent, the respiration is suspended, the body becomes covered with a cold, clammy sweat, and often involuntary micturition or defecation takes place. The tetanic condition, after lasting from fifteen to thirty seconds, gradually diminishes in intensity.

As the convulsions cease, the distortion of the face disappears, the cyanosis diminishes, the eyelids droop, the mouth opens, and frothy saliva, tinged with blood, escapes from the mouth and nostrils. Stertorous respiration marks the beginning of sopor. At first the patient, unless the attack has been of unusual severity, can be roused when spoken to. The depth of the sopor is proportioned to the violence and frequency of the attacks. When the convulsions are repeated, the patient in the intervals can no longer be made to respond to inquiries, but passes into a state of complete unconsciousness. The duration of a single attack rarely exceeds a minute, and in a majority of cases lasts from ten to thirty seconds. On account of the implication of the respiratory muscles, attacks of long duration are scarcely compatible with continued existence (Spiegelberg).

After a single seizure the sopor usually disappears in from one half to two hours, and seldom persists beyond a single day. The number of seizures in a single day may, however, be exceedingly numerous. Thus, seventy convulsions have been reported by Braun,* eighty-one by Brummerstedt,† and one hundred and sixty by Depaul.‡

* Braun, Lehrbuch der gesammt. Gynaekologie, p. 822.

† Brummerstedt, Bericht, etc., Rostock, 1866.

‡ *Vide* Spiegelberg, *loc. cit.*, p. 556.

With very rare exceptions—of which, however, I have never seen an example—the urine after the convulsions is found loaded with albumen, and contains an abundance of renal epithelium, often in a state of fatty degeneration, casts, and sometimes blood-corpuscles. In all cases of exceptional severity the urine is scant or absent altogether.

Terminations.—In favorable cases, after the expulsion of the ovum the attacks cease or diminish in frequency and intensity, the pulse and respirations become quiet, and the coma passes gradually into gentle slumber. On awakening, the patient complains of headache and of impaired memory, and possesses no recollection of the perils through which she has passed. Pains are felt in the muscles, and in the tongue when the latter has been injured to any considerable extent by the teeth.

But even after consciousness returns, the danger is still not ended. Eclampsia predisposes to *post-partum* hæmorrhage and to puerperal inflammations; or it may leave behind hemiplegia, amblyopia, an enfeebled mental condition, or psychical disturbances, especially mania, which, however, usually terminates spontaneously in the course of the first three days.

In fatal cases death results from carbonic-acid poisoning, due to tetanus of the respiratory muscles or to exhaustion of the nervous system. Bailly relates the history of a patient who died of asphyxia, due to swelling of the tongue.

Of anatomical lesions found in *post-mortem* examinations, the most constant are hyperæmia, more often an anæmic state, fatty degeneration, and atrophy of the kidneys. The latter is rare, and in many cases the renal changes are of moderate extent. In thirty-two examinations, Löhlein* found in eight dilatation of one or both ureters and of the pelves of the kidneys. The same author likewise has demonstrated the existence of enlargement of the heart (the comparisons were instituted with those of other pregnant women), indicative of increased arterial tension. The brain-lesions were in most instances insignificant.

Prognosis.—The prognosis is always serious. In Dohrn's collection of 747 cases the death-rate reached 29 per cent; in 104 cases collected by Hofmeier† in Schroeder's Clinic the mortality was 32·4 per cent. A better showing is made by Braun,‡ who was able to report from Vienna in ten years, from 1869 to 1878, 73 cases, with twenty deaths (26 per cent), five from peritonitis and fifteen from Bright's disease alone.

The earlier the convulsions occur in labor, the more unfavorable the prognosis. This is well shown by the statistics of Löhlein. Thus, of eighty-three cases where the first convulsions occurred before or during the first stage of labor, 40·5 per cent of the patients died. Of

* Löhlein, Bemerkungen zur Eklampsiefrage, Ztschr. f. Geburtsh. und Gynæk., Bd. iv, Heft 1, p. 89.

† Hofmeier, *loc. cit.* ‡ Braun, Lehrbuch der ges. Gynæk., p. 833.

fifteen cases where the first stage was completed, but one patient died. Eclampsia, which develops first in childbed, usually pursues a favorable course. Löhlein reports eight cases, with one death, which, however, was the result of infection.

The longer the labor the more difficult the delivery; the deeper the coma and the greater the insufficiency of the kidneys the more depressing is the outlook.

It is very rare for the convulsions to cease previous to the expulsion of the child. According to C. Braun, after delivery in thirty-seven per cent the convulsions cease entirely, in thirty-one per cent they become feebler, while in thirty-two per cent they continue for a time with undiminished severity. In childbed it is of favorable import when copious diuresis sets in, and is followed by the disappearance of the albumen and of the œdema.

As regards the children of eclamptic women, it is estimated that fully one half are born dead, a result probably due to asphyxia from the accumulation of carbonic acid in the blood of the mother. As the results depend upon the number and duration of the attacks, it is evident that the danger is greatly lessened after the completion of the first stage of labor.

Pathology and Etiology.—As in discussions upon eclampsia it is evident that the treatment advocated by physicians is governed almost exclusively by theoretical considerations, it becomes of the utmost importance to place before the student an exact statement of known facts, with an attempt to estimate at their true value the deductions which various observers have drawn from them.

Now, in the first place, in reviewing the foregoing history of the disease, we are brought face to face with the very striking coincidence in the vast majority of cases between renal insufficiency and the convulsive seizures. This insufficiency may or may not be associated with albuminuria, though the two go pretty constantly together. The honor of first drawing attention to the relations between albuminuria and puerperal convulsions belongs to Dr. John C. W. Lever, who reported in Guy's Hospital Reports, second series, 1842, fourteen cases, in ten of which the urine was examined. Albumen was found in greater or less quantity in nine cases; in the *post-mortem* made in the tenth case the death was discovered to have been due to acute meningitis.*

These observations were followed by others from British physicians, among whom may be mentioned Simpson, Garrod, Cormack, and Rees; and in France treatises upon the subject were published by Cohen and Delpech, and by Devilliers and Regnault.

* *Vide* Tyson, The Causal Lesions of Puerperal Convulsions, Philadelphia, 1879. To this excellent summary I desire to acknowledge my indebtedness for a deal of labor saved, as regards the search for references.

In 1851 Frerichs pointed out clearly the close resemblance between the convulsions occurring in pregnancy and the uræmic convulsions of Bright's disease. After reviewing the evidence with scientific precision, he concluded that "true eclampsia occurs only in pregnant women suffering with Bright's disease, and it bears to the latter the same causal relation as convulsions and coma in Bright's disease in general; it is the result of the uræmic intoxication, with which also in its mode of manifestation it agrees." To this view Braun, in the same year, and Wieger, in 1854, brought effective support by the publication of a great number of observations confirmatory, both in respect to the clinical features and the *post-mortem* appearances, of the uræmic origin of puerperal convulsions. In 1857 Braun published one of the most meritorious treatises upon midwifery to be found in any language. In this work the new doctrine was presented with so much skill and clearness that since then, in the minds of the great body of practitioners, the terms eclampsia and uræmia have come to be regarded as synonymous.

In order to understand the present position of the question, it is necessary to review the objections which the uræmic theory has had to encounter. Among its earliest opponents was Seyfert, of Prague, who occupying the vantage-ground as director of the maternity hospital of that place, second only in size to the great maternity at Vienna, furnished the clinical counter-experiences which have since proved the most effective weapons in the hands of those who have regarded the new doctrine as specious and heretical. The facts which, he insisted, invalidated the claims of Frerichs and Braun were as follows: *

1. That convulsions may occur without albuminuria.

2. That the albuminuria is in many cases the effect and not the cause of the convulsions.

3. That in many fatal cases the kidney-lesions were absent or wholly insignificant.

4. That convulsions are rare in chronic Bright's disease which had existed prior to pregnancy.

5. That in true uræmia, such as necessarily is produced by the suppression of urine when, in uterine cancer, the ureters are invaded, convulsions do not occur.

That, in the main, these propositions are correct, hardly admits of question. But, in drawing conclusions from these, unnecessary stress is laid upon the presence or absence of albumen in the urinary secretion. It is the renal insufficiency, it should be fixed in the mind, and not the albuminuria, which is associated with convulsions. The mere

* As I have copied this list from notes taken from the lectures of Seyfert, delivered in the summer session of 1865, I shall not consider it necessary to more than incidentally refer to the corroborative testimony since advanced in support of their validity.

absence of albumen from the urine does not even exclude the existence of Bright's disease. Braun is careful to note that in certain cases of fatal eclampsia, in spite of the absence of albuminuria, the *post-mortem* examination revealed amyloid degeneration of the kidneys and of the heart-structures; and, again, in others, of atrophy of both kidneys, where the dropsy, and the albumen, and casts, which had been present earlier in pregnancy, had entirely disappeared at the moment the convulsions occurred. Bailly has shown that not rarely albuminuria in pregnant women may disappear for several hours and then reappear once more, so that it is possible for an examination to be made during the short period when the urine ceases to be albuminous.

On the other hand, chronic nephritis does not necessarily imply insufficiency of the renal secretion. Seyfert reported over 70 cases where women suffering from Bright's disease became pregnant; only two of these had convulsions. Every observer has seen similar instances of immunity. Nephritis in pregnancy brings with it its own peculiar dangers. Of forty-six cases, chronic in character, reported by Hofmeier, only one third of the patients had eclampsia, but one half died. Including acute and chronic cases together, Braun estimates that only sixty in the hundred develop uræmic convulsions. Hofmeier found, in five thousand births recorded upon the history-books of the Berlin Clinic 137 cases of nephritis entered. Of these, 104 patients only were attacked with eclampsia. Professor Bamberger* reports from autopsies of the "allgemeinen Krankenhaus" in twelve years 2,430 cases of Bright's disease, of which 152 were found in puerperal and pregnant women, viz., 80 acute cases, 56 chronic cases, and 16 cases of atrophy; puerperal eclampsia was recorded in 23 instances.

Flaischlen† found in examining 1,000 cases of pregnancy that albumen was present in twenty-six. In five of the cases the patients suffered from catarrh of the bladder, and in two chronic nephritis was diagnosed, leaving nineteen per thousand in which albuminuria was dependent upon pregnancy. Of 537 cases (205 primiparæ, 242 multiparæ) observed during labor or immediately after childbirth, albuminuria was present in 93 women, of whom 73 were primiparæ and only 20 were multiparæ. As the estimated frequency of eclampsia is only 1 to 500 cases of pregnancy, the mere presence of albumen is not necessarily of grave prognostic importance.

Löhlein examined the records of thirty-two autopsies made upon eclamptic women, and found in eight, or in twenty-five per cent of the entire number, that dilatation of one or both ureters coexisted with renal disturbances. He, therefore, pertinently inquires how far sim-

* Bamberger, Ueber Morbus Brightii und seine Beziehungen zu anderen Krankheiten, Volkmann's Samml. klin. Vortr., No. 173, p. 1541.

† Flaischlen, Ueber Schwangerschafts und Geburtsnieren, Ztschr. f. Geb. und Gynaek., vol. viii, p. 358.

ple mechanical obstruction of the ureters may explain the apparent development of uræmic manifestations in certain cases without the warning furnished by albumen in the urine.

Finally, it is not claimed by even the most stalwart champions of the uræmic nature of eclampsia that the convulsions which occur during pregnancy and labor are invariably the result of the same cause. Thus, Tyson says: "There are no reasons why we should exclude from the causes of the convulsions in the puerperal state those which operate to produce convulsions in the non-puerperal condition." So-called cases of eclampsia without albuminuria, i. e., without uræmia, are admitted by Braun and Spiegelberg, and referred by them to reflex stimulation of the vaso-motor and convulsive centers (Krampfcentren). They advocate, however, separating them off into a class by themselves under the title of acute epilepsy, or eclamptiform attacks, a distinction they believe warranted by their rarity and their benign behavior.

The objection drawn from the insignificance of the kidney changes, frequently observed in *post-mortem* examinations, loses most of its force when we remember that in a large proportion of cases the retention of excrementitious materials is due to acute suppression. Thus, in the 104 cases of eclampsia reported by Hofmeier, the kidney symptoms developed suddenly. This sudden suspension of the urinary secretion can only result, Spiegelberg * argues, from disturbances in the renal circulation. A rapidly developed affection of the vessels would leave no marked *post-mortem* traces, and would, in cases of recovery, disappear as quickly as it had come. Were the kidney troubles due principally, as was formerly supposed, to pressure of the gravid uterus upon the renal veins, the kidneys should, in *post-mortem* examinations, exhibit evidences of congestion; whereas, usually they are, on the contrary, found to be pale and anæmic. Besides, in cases of pressure from ovarian and pelvic tumors it is usually the ureters and not the veins which are implicated. The precise nature of the circulatory changes is not, of course, definitely known. Spiegelberg suggests that either the walls of the vessels are altered in such a manner as to interfere with the process of diffusion, or that a reflex contraction of the vessels due to a peripheral stimulus operates to cut off the blood-supplies to the kidneys. Frankenhaeuser, having demonstrated a direct connection by means of the sympathetic nerve between the ganglia of the kidneys and the nerve-filaments of the uterus, had likewise suggested in effect that the albuminuria of pregnancy was due not to pressure but to the excitation of the uterine and renal nerve plexuses.

Cohnheim supposes that the renal changes of pregnancy are due primarily to reflex contraction of the arterioles of the kidney, and that the albuminuria and the epithelial degeneration are secondary phe-

* Spiegelberg, Lehrbuch, p. 561.

nomena. Experimentally, Litten has shown that similar results follow upon the temporary narrowing of the renal afferent vessels by means of ligatures.*

The statement contained in the fifth proposition relates to a curious fact, which has since received confirmation from the pathological investigations of Cornil and Ranvier. In a very large proportion of women who had died from uterine cancer the ureters were found occluded, with attendant dilatation and in some cases with hydronephrosis. Of these Cornil wrote: "With these obstacles to the excretion of urine we expected uræmic symptoms to be manifested, but they were not. Although the attention of M. Charcot and myself was fixed upon this point, we never saw either the epileptiform convulsions or the coma peculiar to uræmic poisoning."

A very different interest attaches itself, however, to the inquiry as to the causes of the outbreak of convulsions. It is well known that not every case of nephritis, or even of kidney insufficiency, is followed by eclampsia, though convulsive attacks are much more common in the uræmia of pregnant than of non-pregnant women. Frerichs believed he had found the secret in supposing a ferment to develop in the blood, which converted the urea into carbonate of ammonia. In 1870 Spiegelberg reported an examination of the blood of an eclamptic woman by the latest methods, and demonstrated the presence of ammonia in quantities sufficient to give color to the supposition of Frerichs; but, subsequent investigations proving negative, he concluded that "ammoniæmia is to be regarded as one of the rarest causes of convulsions."

An apparently much more scientific explanation was afforded by the now well-known Traube-Rosenstein theory, which maintained that eclampsia took place when, in persons rendered hydræmic by the loss of albumen, the aortic pressure was suddenly increased, the increased pressure giving rise successively to œdema of the brain, then to secondary compression of the vessels, and finally to acute anæmia. An anæmic condition of the hemispheres would, it was predicted, produce coma, while convulsions would ensue if the condition extended to the motor centers.

The plausibility of this hypothesis was increased by the widespread acceptance of the doctrine taught by Andral and Gavarret, that the blood of all pregnant women is hydræmic, and by the fact that the existence of increased blood-pressure during the pains seemed naturally to account for the frequency of convulsions in labor. For a number of years after the announcement of the Traube-Rosenstein theory it received from me complete acceptance; but my faith became afterward weakened by failing to find at *post-mortem* examinations the an-

* Osthoff, Beiträge zur Lehre von der Eclampsie und Uraemie, Sammlung klin. Vorträge, No. 206, p. 1911.

ticipated brain-changes, viz., œdema, anæmia, and flattening of the convolutions. In nineteen examinations, Löhlein reported these alterations in but a single case. In his Lehrbuch der Geburtshülfe Spiegelberg sums up the objections in a somewhat contemptuous fashion. First he asks why, if the pathogenetic symptoms, as assumed, are invariably present, eclampsia is of such rare occurrence, and in what way the theory in question affords any explanation of eclampsia in pregnancy and childbed: then he denies that eclamptic women are for the most part hydræmic, that hydræmia and arterial pressure are capable of inducing cerebral anæmia, and that the clinical evidences afforded by the pulse and pupils are those produced by œdema.

Angus Macdonald reported in 1878 that in the examination of the brain in eclamptic persons he found the meninges congested and the venous sinuses filled with blood, while at the same time there was marked anæmia in the deeper layers of the brain-structure. The ventricles, in place of being empty, as should have been the case according to the Traube-Rosenstein theory of œdematous swelling, were found filled with serum. In place of the doctrine of secondary compression, he expressed his belief that the anæmia resulted from arterial contraction due to irritation of the vaso-motor centers from excrementitious principles retained in the circulation by the insufficiency of the kidneys. The ingenious theory of Macdonald, however, still leaves unexplained the absence of convulsions in cases where the tissues are necessarily loaded with urea, and their occurrence in instances where either no kidney lesions were present, or where the kidney and cerebral symptoms were coincident.

The disposition to ascribe convulsions to cerebral anæmia is based upon the experiments of Kussmaul and Tenner, who demonstrated that convulsive twitchings might be produced in animals by tying the carotids or by opening the large vessels of the neck and allowing them to bleed to death. It is, of course, anticipated that anæmia due to systole of the arterioles would be followed by the same results. The phenomena of convulsions are twofold, viz., loss of consciousness and tonic and clonic contractions. Loss of consciousness is easily to be accounted for by anæmia of the hemispheres, precisely as in cases of ordinary syncope. Convulsions occur, however, when the brain is removed, if only the pons Varolii and the medulla oblongata are preserved. Deiters has shown that the motor fibers of the extremities and the trunk have their first central terminations in the pons. Nothnagel * has proved that a collection of ganglionic cells in the substance of the pons furnishes the motor center from which the convulsive impetus takes its departure. According to Schroeder van der Kolk, the groups of gray matter for the cranial nerves are situated in the floor

* Nothnagel, Ueber den epileptischen Anfall, Volkmann's Samml. klin. Vortr., No. 39, p. 313.

of the fourth ventricle and in the substance of the medulla oblongata. Any influence producing contractions of the arterioles through the vaso-motor nerves would necessarily produce both coma and convulsions. As, however, convulsions may take place without loss of consciousness, Nothnagel concludes that the same cause which acts indirectly through the vaso-motor nerves may independently set in action the centers of muscular movements.

The foregoing considerations have led writers to divide convulsions into two classes, viz., those due to centric causes and those proceeding from peripheral irritation. In both, cerebral anæmia plays an important part. In the overwhelming proportion of cases, uræmia is regarded as the fountain and origin of the evil, the term *uræmia* signifying, of course, the action, not of a single constituent of the urine, but of all the excrementitious principles, combined with that of increased arterial tension. Whether, in exceptional cases, carbonate of ammonia or cerebral œdema is present, is a matter of slight moment. The *rôle* played by peripheral irritation is not, however, to be overlooked. Without uræmia, though rarely, peripheral irritation can provoke eclampsia. In uræmic cases the greater proportion develop during labor. In Löhlein's collection, a hundred and six in number, ninety-three of the patients were parturient. Spiegelberg has frequently seen convulsions awakened in the placental period by the mechanical irritation of the uterus during the employment of the Credé method of expression.

It may be assumed that the special source of irritation is derived from uterine contractions, which the observations of Braxton Hicks and Frommel show are not confined to the time of actual labor, but occurs spontaneously during the entire duration of pregnancy, and continue through the retrograde changes of the childbed period. Osthoff,* indeed, concludes that all cases of eclampsia have equally a reflex origin. Thus, an irritation proceeding from the uterus may be transmitted through the sympathetic nerves to the kidney alone, exciting contraction of the arterioles or, when sufficiently intense, it may travel upward to the vaso-motor center in the medulla oblongata, and be followed by contractions of the arterioles of the entire body. Evidence of such general contraction is supplied by the high tension and sluggishness of the pulse, while the resulting anæmia of the great nerve-centers furnishes the occasion of the epileptic attack.

The advantage of this formula as a working hypothesis is that it renders intelligible what the uræmic theory has failed to do, the occurrence of eclampsia without kidney lesion, the frequent presence of kidney derangement without eclampsia, and the special gravity of eclampsia when complicated by kidney derangement. In questioning the

* Osthoff, Beiträge zur Lehre von der Eclampsie und Uraemie, Volkmann'sche Sammlung klin. Vorträge, No. 296.

connection between uræmia and eclampsia, the danger to life from the retention in the circulation of excrementitious materials is in no wise disputed.

Convulsions occur more commonly in primiparæ than in multiparæ, especially in elderly primiparæ, in twin pregnancies, and in women with contracted pelves. They may occur epidemically in consequence of atmospheric conditions, which probably interfere with the functions of the skin, and thus indirectly increase the labor thrown upon the kidneys.

Treatment.—The occasional examination of the urine of pregnant women is to be regarded as an indispensable precaution. Faint traces of albumen are not infrequently found in the urine of women with harmless catarrhal affections of the bladder. Persistent albuminuria calls for special prophylactic treatment; for, though convulsions are not to be regarded as the necessary consequence of nephritis, the presence of renal disease immensely increases the danger of sudden acute suppression. Nephritis is, moreover, apt to be aggravated by the pregnant state, and Hofmeier has shown that in a considerable proportion of the cases which have their origin in pregnancy the kidney-lesions, contrary to the accepted belief, do not disappear spontaneously after parturition. Flaischlen has, however, recently challenged Hofmeier's conclusions. The true renal lesion of pregnancy he regards as due to anæmia of reflex origin, the primary consequence of which is anatomically an alteration in the epithelium of the glomeruli, and clinically albumen in the urine without sediment. In its subsequent course degenerative changes take place in the epithelium of the canaliculi, and great quantities of albumen with cylinders and epithelia are found in the urine. It occurs first about the middle, or, more frequently, toward the close of pregnancy. As distinguished from chronic nephritis, in which the specific gravity of the urine is low and the quantity increased, the specific gravity is high and the quantity diminished. The transition of this form into chronic nephritis he regards as not proved, and *a priori* improbable.*

Every precaution should be taken, therefore, to remove from albuminuric patients all sources of mental excitement, to ward off attacks of indigestion, and to defend them from colds. In œdema of the face, the extremities, and the labia majora, a strict milk diet should be enjoined, and the tincture of the chloride of iron, in full doses, should be given at least four times a day, both for its diuretic and for its hæmatinic properties, and likewise to improve the *tonus* of the weakened vessels. If the milk diet is badly supported by the patient, she should be instructed to drink freely of the natural alkaline waters possessing mildly diuretic properties, such as the Vichy, the Selters, the Buffalo lithia-water, the Poland water, and others of like action. To remove

* Ztschr. f. Geburtsh. und Gynæk., vol. viii. p. 354.

the transuded serum, the skin should be compelled to aid the kidneys, either by means of the Turkish bath or, where the latter is not available, by the wet-pack. Mild laxatives, such as the Friedrichshall, the Hunyadi, or the Saratoga waters, are useful in constipation of the bowels.

If cerebral symptoms threaten the outbreak of convulsions, the nervous irritability should be held in check by rectal injections of chloral and the bromide of potassium (thirty grains each), and a hydragogue cathartic should be promptly administered. Free catharsis unloads the blood of urea, diminishes the arterial tension, and relaxes the arterioles. The immediate results are usually in the highest degree satisfactory. The pain in the head, the sensory disturbances, the stomach troubles disappear, and the patient becomes calm or sinks into a gentle sleep. Löhlein recommends placing the woman in the latero-prone position, in order to diminish as much as possible the pressure upon the ureters and upon the renal veins.

So far writers are practically unanimous. Whatever differences exist between them relate not to principles, but to the means best adapted to accomplish the end in view. When, however, in spite of palliative measures and hygienic precautions, the uræmic symptoms have steadily progressed until the central nervous system has become involved, the question comes up for decision whether to persevere in a plan of treatment designed merely to ward off impending danger, or whether to place the patient without delay in a position of relative safety by the induction of premature labor. The weight of authority, it seems to me, is favorable to procrastination, the interruption of pregnancy being regarded as an extreme measure, justifiable only in cases of utmost peril. But premature labor with the indications thus limited, is not likely to save many lives. My own convictions are clear that, so soon as grave cerebral symptons develop, the period of folded hands has passed. The relief to be obtained from chloral and catharsis is, as a rule, of short duration, and we can not go on giving chloral and cathartics to the end of gestation, nor are we sure that the first fortunate results can be reduplicated. Moreover, it is necessary to take cognizance of the well-being of the fœtus, which is threatened by the continued circulation of urea in the maternal blood. The induction of premature labor by means of the bougie, aided, if needful, by the vaginal douche and the dilating bags of Barnes, is attended with but moderate risk if resorted to after the uræmic symptoms have been got fairly under control; if employed as a last resource, where other therapeutical measures have failed, its use is still justifiable, though it then partakes rather of the nature of a forlorn hope.

The indications for treatment during the outbreak are for the most part the same as laid down for uræmic symptoms unattended by con-

vulsions, viz., to lower the arterial tension, to diminish to the fullest extent practicable the irritation of the vaso-motor and convulsive centers, and to restore to the kidneys their normal functions. Spiegelberg claims that these three indications are most completely fulfilled by venesection. Professor Fordyce Barker pleaded for the restoration of the lancet in the management of puerperal convulsions, insisting upon the unmistakable clinical evidences favorable to its employment. In my student-days in Paris, at the Hôpital des Cliniques, where the ancient usage was in full favor, I well remember my first feelings of alarm at the vigor of the treatment in vogue; but, after carefully watching the cases to the end, I was led to conclude that the claims of bleeding in eclampsia rested upon a substantial foundation.

The special advantage of venesection lies in the rapidity of its action; incidentally it favors absorption and renders the patient more susceptible to the influence of other remedies. It forms, therefore, naturally the first step in the treatment of convulsions. The quantity of blood to be withdrawn varies from eight to sixteen ounces, according to the vigor, and, to some extent, according to the size, of the individual.

In the May number of the American Journal of Obstetrics, 1871, Dr. H. Fearn, of Brooklyn, contributed an article on Veratrum Viride in Large Doses, as a Substitute for Bloodletting in Puerperal Convulsions, in which he recommended the tincture of veratrum in doses varying from fifteen minims to a teaspoonful, repeated every five or ten minutes until the pulse became soft, or vomiting set in. For several hours after the convulsions are arrested he advises the veratrum to be administered in smaller doses, in order to keep the pulse below fifty to the minute. He claims that the large doses are devoid of danger so long as the convulsions continue. According to Kenyon,* who has recently contributed two cases successfully treated by veratrum, "the drug is quickly absorbed, and enters the circulation rapidly. It enters the vasa vasorum, and through them impairs the sensibility of the vaso-motor nerves, the blood-vessels thus losing their tonicity and power of contraction"—all good arguments for its use in convulsions if its safety can be established.

After bleeding, narcotics and anæsthetics should be resorted to, with a view of preventing the renewal of the convulsions. Chloroform and morphine have long been tested in practice, and have sustained their claims to professional favor. From one sixth to one fourth of a grain of morphine should be injected hypodermically, the same quantity to be repeated in an hour in case of the convulsions returning. Chloroform was formerly recommended in full anæsthetic doses, so as to completely paralyze the motor centers. As, however, experience has shown that complete and prolonged anæsthesia is in itself a source of danger, it is advisable, except in cases where labor is nearly at a close,

* Kenyon, Treatment of Convulsions with Veratrum Viride, N. Y. Med. Jour., October, 1879, p. 370.

to restrict the chloroform to the pains, and to the restlessness which is often the preliminary of a fresh seizure.

The discovery of chloral has added another invaluable agent to our list of available antispasmodics and anæsthetics. It is my present practice, after beginning with chloroform, to administer thirty grains, each, of chloral and bromide of potassium by the rectum, and to suspend the chloroform so soon as the sedative effects of the latter agents become developed. The frequency with which the chloral should be given depends upon the frequency and violence of the attacks. A single dose will sometimes exercise a restraining influence for hours, while in other cases in the course of an hour or two the dose will require to be repeated. As a subsidiary measure, with a view to the ultimate relief of the kidneys, the lower bowel should be cleared out with an enema, and a cathartic (a drop of croton-oil, or calomel and jalap in case the patient is able to swallow) should be given by mouth.

Breus* warmly recommends the use of the hot bath as a prophylactic measure in the renal affections of pregnancy, and as a measure of treatment in conjunction with chloral during the eclamptic attack. The plan he recommends consists in placing the patient up to the neck in a bath of a temperature at first of about 102°, which should be gradually increased to 110° or 112° Fahr. The bed for the reception of the patient should be spread with two blankets covered by a warmed sheet. After a half-hour the patient should be removed from the bath, wrapped in a warm sheet, and placed upon the bed. She should then be enveloped in the blankets with only the face free, and two more blankets should be laid above the preceding. In a few minutes profuse perspiration sets in, and should be maintained for from two to three hours The covers should then be removed gradually. For thirst he gives soda or other sparkling waters. After the sweating, the patients ordinarily sleep a few hours, when they feel well. A comatose condition is no contra-indication, but renders the procedure more difficult. The diaphoresis rapidly diminishes the dropsical symptoms, and is followed by a decided diminution in the amount of albumen in the urine.

As convulsions which occur after the advent of labor have a tendency to recur so long as the labor continues, and in the larger proportion of cases cease after the birth of the child, every obstetrical resource compatible with the safety of the mother should be employed to hasten delivery. In the early part of the first stage the pains, if sluggish, should be stimulated by catheterization of the uterus. Braun advocates rupturing the membranes, as he claims that the escape of the amniotic fluid often diminishes the frequency and violence of the convulsions. The water-bags of Dr. Barnes, if necessary, should be

* Breus, Zur Therapie der puerperalen Eclampsie, Arch. f. Gynaek., vol. xix, p. 219.

used to promote the dilatation of the cervix. Incisions through the border of the os externum and *accouchement forcé* are unnecessary. After the first stage is completed, if no mechanical disproportion exists between the head and the pelvis, a careful attempt to extract the child with forceps should be made. Every precaution should be used to avoid injuring the softs parts. Obstetrical aid is only warrantable where it can be employed without detriment to the mother. In instrumental cases, with the head high in the pelvis, I have had every reason to feel satisfied with the Tarnier forceps, exchanging it, however, for one of English pattern so soon as the head is brought to the floor of the pelvis.

When convulsions occur during pregnancy, the question as to the advisability of at once provoking labor is by no means settled. The material upon which to form an opinion is limited, as in most cases labor-pains occur spontaneously (as a consequence of the convulsions). Where medical treatment alone is employed it is certain that, in the absence of labor-pains, a certain proportion recover, and pregnancy may go on to completion. On this account it is commonly advised not to introduce labor as a complication into a state of affairs already sufficiently dangerous and difficult to manage. So far as my own experience goes, however, the practice of waiting upon Nature has proved uniformly disastrous, while the induction of labor has furnished me with a certain proportion of recoveries. Braun declares he has known but one patient to recover between the fourth and sixth months of pregnancy except where abortion had taken place. The question is one, however, concerning which there exists a reasonable degree of doubt, and which can not be settled by the hap-hazard experiences of individuals.

In the treatment of convulsions during the childbed period the agents used should be opium, chloral, veratrum, or digitalis. Chloroform and venesection should be employed with extreme caution, if, indeed, they are ever entitled to confidence at that time.

CHAPTER XXXI.

POST-PARTUM HÆMORRHAGE AND RETAINED PLACENTA.

Normal agencies for checking hæmorrhage.—Disturbances of contractility, of retractility, of thrombus formation.—Treatment.—Method of securing contraction and retraction.—Treatment of cerebral anæmia.—Retained placenta.

The hæmorrhages which occur immediately after the birth of the child may have their origin in the uterus, the vagina, or the vulva. It is customary, however, to consider those which spring from lacera-

tions in a chapter by themselves, and to apply the term *post-partum* to those hæmorrhages only which arise from the placental site.

Unlike other grave complications of childbirth, *post-partum* hæmorrhage is not an uncommon event. It may follow the simplest of labors, and, in case of an unprepared physician, it may carry his patient in a few moments to the brink of death. It is impossible to conceive a tragedy more terrible than this. Occurring, as the accident does, suddenly, without warning, in the period of joy that follows the birth of a living child, the sudden shifting of the scene becomes appalling. If the mother dies at such a time, the luckless attendant who stands at her bedside, a nerveless spectator, need never expect forgiveness; nor can he shield himself behind the recorded ill-successes of others. Every competent accoucheur knows in his own heart that he has no right to shirk his personal responsibility in cases of fatal *post-partum* hæmorrhage, or to meanly throw the blame upon Providence.

The treatment of *post-partum* hæmorrhage is one of the most satisfactory departments of obstetrical practice. In no other emergency is the saving of life so little dependent upon chance, and so much upon intelligent human intervention. Successful treatment is, however, less the result of a familiarity with the various procedures extolled by writers, than of a correct understanding of the mechanism by means of which the arrest of the hæmorrhage is to be effected.

Normal Agencies for checking Hæmorrhage.—In normal cases the flow which follows the detachment of the placenta is of brief duration. The torn arterial twigs retract spontaneously, the patulous mouths of the veins become plugged with fibrinous clots, while the so-called venous sinuses, which are simply channels lined with endothelium, without valves or walls, become bent, flattened, and obliterated under the compression exerted by the muscular structures of the uterus.

The first requisite against hæmorrhage is the maintenance of firm uniform contraction of the uterus. The contractions, which persist with lessened force after the birth of the child, during their continuance alone suffice to prevent hæmorrhage from the placental site. The two diagrams borrowed from Professor Breisky serve to illustrate the mechanism by which this is effected. In the transition from *a* to *b* the uterus, which shortly before harbored the entire ovum, becomes reduced to a body not larger than the two fists. But the duration of the contractions is short, with an ever-increasing interval between them. If their cessation were followed by the return of the uterus from *b* to *a*, the blood would once more rush into the sinuses, the mouth of the veins would open, the thrombi would be washed out by the pressure brought to bear upon them, and flooding would of necessity ensue. That this does not take place is owing to the same force which in labor keeps the uterus closed upon its contents during the descent of the fœtus—viz., tonic retraction.

The tonic retraction of the uterus is in part the consequence of shortening of the muscular fibers, and in part of their rearrangement, a thickening of the uterine walls resulting, as the cell-elements, in place of standing end to end, assume a position more nearly parallel to one

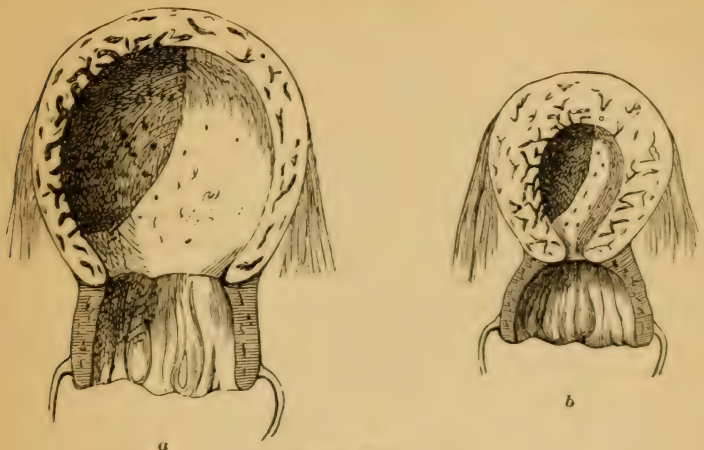


FIG. 223.

another. Retraction is a permanent acquisition of the uterus, and alone suffices to prevent the occurrence of hæmorrhage. The difference between it and contraction is exhibited by the difference in the consistence of the *post-partum* uterus during and between the pains. The contracted uterus is hard and firm like a billiard-ball, while the retracted organ is relatively soft and relaxed. The two properties, though distinct, are not, however, independent of one another. Whenever the contractions are good, the retraction is well marked also. Whatever diminishes the contractile powers of the uterus is followed by a corresponding falling off as regards its retraction.

In cases where the muscular structures of the uterus fulfill their normal functions, the formation of thrombi is of subordinate importance as a means of arresting hæmorrhage. Confined to the adherent portion of the decidua serotina, they impart an uneven surface to the placental site. Thrombi which extend to the intermuscular veins are pathological. It is only when the uterus is flabby, and the muscular action is in default, that the thrombi exercise any marked influence in the control of hæmorrhage, and even then they bear so close a relationship to puerperal thrombosis as to approach dangerously near to the confines of pathology.

The causes of *post-partum* hæmorrhage are to be sought for in disturbances of the mechanism by which hæmorrhage is normally prevented.

Disturbances of Contractility.—Contractions of the uterus may fail

from lowering of the muscular irritability. Atony follows most frequently exhausting labor, artificial deliveries, rapid evacuation of the uterus, especially in multiparæ, where the failure to contract has often the significance of a prolonged pause, excessive distention (hydramnios, twins), profuse hæmorrhages, collapse, nervous depression, and severe general ailments.

Again, in other cases, the functional disturbance may proceed from some abnormal condition of the muscular fiber. Thus, the defects of contractility may spring from incomplete development, as in anomalies of formation, in textural changes due to some antecedent disease or puerperal condition, especially as to the result of many previous confinements, or finally from inflammatory infiltrations having their source in the bruising of the lower uterine segment during labor.

The contractions of the uterus may be mechanically interfered with over limited areas by retained portions of the placenta and of the membranes, by peritoneal adhesions, by tumors in the walls of the uterus or in the uterine appendages, or by a distended bladder or rectum.

Disturbances of Retractility.—We have already seen that the *tonus* of the muscular fibers is lowered, and that their rearrangement is incomplete, whenever the uterine contractions are in default. At the same time the retraction of the uterus may be directly hindered by mechanical causes, especially by those which, like the placenta, the membranes, or coagula of blood, when retained in the uterine cavity, prevent, in spite of continued contractions, a sufficient closure of the veins.

Disturbances in Thrombus Formation.—The disturbances which interfere with the formation of thrombi occur for the most part in those cases in which, owing to the defective action of the muscular structures, the blood-stream arrives at the mouths of the vessels with unchecked rapidity. As a consequence, coagulation does not take place, or the coagula are of soft consistence, and offer but feeble resistance to any sudden increase of blood-pressure, or become mechanically detached by restless movements on the part of the patient, or by straining with the abdominal muscles.

Outlying Causes of Post-partum Hæmorrhage.—The remote causes of *post-partum* hæmorrhage—i e., those not immediately connected with the uterus—all act by indirectly interfering with either the contractility or the *tonus* of the muscular fiber, or with the thrombus formation. This they do by influences exerted either through the nervous system or through the circulation. Thus, the muscular irritability may be impaired by general debility, by wasting diseases, from impoverishment of the blood due to suffering and muscular effort, from psychical impressions, and from the external influences of heat and vitiated air. The normal *tonus* of the uterine muscles may be over-

come, and the formation of thrombi disturbed, by any condition of the circulatory system associated with increased pressure in the venous or arterial trunks. The pressure in the uterine veins may be augmented by the patient's getting up suddenly in bed, by acts such as coughing, laughing, sneezing, vomiting, and defecation, in which the abdominal muscles are called into play, and by all the conditions which produce chronic congestion of the pelvic organs. Increase of arterial tension as a cause of hæmorrhage is rare. Breisky mentions a case where, in a multipara without valvular heart-disease, the cause of the hæmorrhage was apparently due to intense palpitation of the heart associated with the hard, incompressible pulse indicative of arterial fullness.*

Treatment.—It is not necessary to dwell upon prophylactic measures. As has been shown in the survey of the causes of *post-partum* hæmorrhage, they comprise everything that has been said concerning the proper management of labor.

Methods of securing Uterine Contractions.—It is my own practice, and one I would urge upon others, to make provision in the simplest of cases against the possible occurrence of hæmorrhage. In the beginning of the second stage, I examine my Davidson syringe to make sure that the valves are in good working order. I then direct a small table to be set by the bedside of my patient, and place upon it a bowl containing pieces of ice of about the size of a hen's-egg, brandy, sulphuric ether, neutral perchloride of iron, carbolic acid, ergot, a solution of morphia, a can of iodoform gauze, and a hypodermic syringe filled with a fluid extract of ergot or two grains of ergotin in solution. Within easy reach I likewise have placed a pitcher of hot water, another of cold water, an empty basin containing the Davidson, or, still better, a fountain syringe, and a bed-pan. All this requires but a few moments' time, and it is of no mean advantage to feel, in case hæmorrhage follows the birth of the child, that all the appliances for prompt action are in order and close at hand.

If hæmorrhage takes place, in spite of the fact that the uterus has been carefully guarded by external pressure during the period of delivery, draw the pillows from under the head of the patient, direct the nurse to open the windows, and inject the ergot contained in the hypodermic syringe into the outer surface of the thigh. Ergot by the mouth acts too slowly to prove of service in the face of a great emergency; besides, in many patients ergot by the mouth excites nausea, and is not absorbed by the stomach; hypodermically its action is, as a

* The foregoing description is little more than a transcript of the principles enunciated in Breisky's clinical lecture, Ueber die Behandlung der puerperalen Blutungen (Volkmann's Samml. klin. Vortr., No. 14, 1871). I have found them of the utmost service to me in practice during the ten years past, and believe with Breisky that they furnish the key to successful prophylaxis and treatment.

rule, rapidly developed. Then introduce the hand into the uterus. If a full bladder interferes, draw off the urine with a catheter.

The introduction of the hand into the uterus I believe to be a matter of the utmost importance. When combined with external pressure it stimulates the uterus to contract. The placenta, if adherent, should be detached with the tips of the fingers; if loose within the uterine cavity, it should be withdrawn slowly, taking care to remove the membranes entire. Bits of placenta or strips of membrane should be carefully scraped from the uterus, remembering that this is most easily effected during the contraction of the organ. Even if the placenta and membranes are expelled apparently entire, it is still desirable to pass the hand into the uterus to clear out clots, and to make sure that no part of the ovum has been left behind. Once I lost a hospital patient by neglecting this rule. The hæmorrhage was checked by compression, and upon careful inspection of the placenta and membranes I convinced myself that everything had come away. The patient died on the eighth day, of septicæmia. The autopsy revealed the presence of a small placenta succenturiata, of the existence of which, aside from the hæmorrhage, there had not been the slightest indication.

So soon as the uterus has been emptied of everything capable of preventing contraction and retraction from taking place, withdraw the

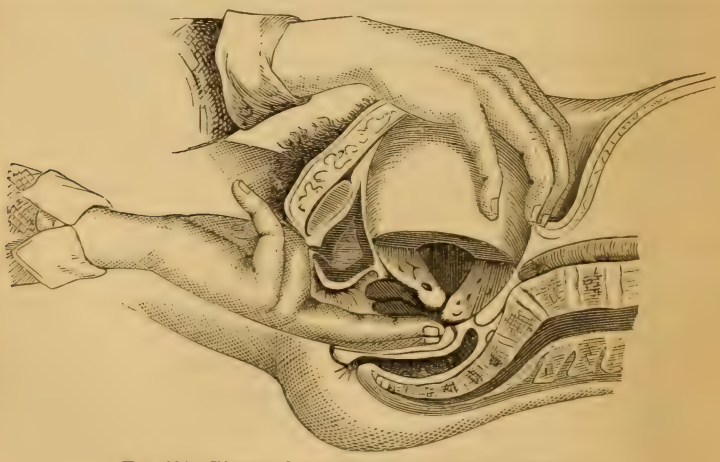


FIG. 224.—Bimanual compression of uterus. (Breisky.)

hand into the vagina, and, with the index and middle fingers in the posterior *cul-de-sac*, press the cervix forward toward the body of the uterus. With the external hand grasp the uterus through the abdominal walls, compress it firmly and push it downward toward the pelvis and forward against the pubic bone. By this manœuvre the cervix is closed, the uterine walls are brought into contact with one another, and con-

tractions are stimulated by the direct irritation of the large cervical ganglion and by the kneading of the fundus. Breisky states that in many cases it is possible to combine compression of the aorta with the foregoing manipulation.

If bimanual compression fails to speedily secure contractions, without removing the internal hand, pieces of ice may be slipped into the vagina, and thence pushed upward into the uterine cavity. With rare exceptions the uterus responds at once to the stimulus of cold applied to its inner surface. Should it not do so, however, the bed-pan should be placed under the hips, and boiled water of about 112° Fahr. should be injected into the uterus, care being taken to expel previously all air from the tube of the syringe. The injection should be made slowly and without force, allowing the fluid to escape *pari passu* with its introduction.

The most important factor in the arrest of hæmorrhage unquestionably consists in acting promptly upon the first signal of danger. If through lack of preparation profuse hæmorrhage should occur, the overcoming of the resulting atony may tax to the utmost the resources of the attendant. As an effective remedy against this condition the per-salts of iron added to the intra-uterine douche still enjoys professional favor. It is, however, many years since I have found it necessary to resort to their use. This I consider fortunate, for, though there is abundant testimony as to the efficacy of the per-salts of iron in *post-partum* hæmorrhage, the arrest of the flow appears, in some cases at least, to have been achieved at too dear a price. Barnes refers the hæmostatic effect of the iron—1. To its direct action in coagulating the blood in the mouths of the vessels; 2. To its action as a powerful astringent on the inner membrane of the uterus, whereby the surface becomes corrugated and the mouths of the vessels are constringed; 3. To the fact that it often provokes some amount of contractile action of the muscular wall. Trask, in recommending the substitution of tincture of iodine for the solution of the perchloride of iron, maintains that it is the third mode of action that should be placed first in the order of importance. This corresponds with my own experience. In two cases where Monsel's solution was used the uterus contracted promptly, and the injection was followed by no disturbing effects. In the third the uterus remained large and flaccid, notwithstanding the hæmorrhage was arrested. For two days the patient did well; on the third the lochia became excessively offensive, the respirations stertorous, and the pupils dilated; general paralysis ensued, and death followed within twenty-four hours of the attack. Although no autopsy was made, it was clear to me at the time that the coagulation had followed the vessels to the substance of the uterus, and that the fatal result was due to the absorption of septic material by the large, soft thrombi, which, by their disintegration, became the means of conveying infection to

the remoter portions of the organism. Barnes formerly used the perchloride of iron after preliminary removal of the clots, in the proportion of one of iron to three of water. Most German authorities recommend the iron in a much more diluted form, and using it in no fixed proportion, but simply to pour the iron, following Seyfert's prescription, into the water until the latter assumes a deep wine-color. In his later writings Barnes seems to regard a mixture of one part of perchloride to ten or twelve of water as adequate.

Wallace * praises vinegar as a certain and safe remedy for *post-partum* hæmorrhage: "I pour a few tablespoonfuls into a vessel," he says, "dip into it some clean rag or a clean pocket-handkerchief. I then carry the saturated rag with my hand into the cavity of the uterus, and squeeze it; the effect of the vinegar flowing over the sides of the cavity of the uterus and the vagina is magical. The relaxed and flabby uterine muscle instantly responds. The organ assumes what I will term its gizzard-like feel, shrinking down upon and compressing the operating hand, and in the vast majority of cases the hæmorrhage ceases instantly. Should one application fail to secure a sufficient contraction, the rag can be withdrawn, and a second or even a third can be made, until the uterus shall contract sufficiently to stop the flow of blood."

Probably the faradaic current is a most efficient agent in securing contractions of the uterus, but, unlike vinegar and hot water, a battery is rarely on hand when needed. An olive-shaped bulb electrode should be introduced into the uterus, and the other pole, a flat disk, pressed upon the fundus; or both poles may be applied directly over the uterus through the abdominal walls.

I have in a number of instances seen Dr. I. E. Taylor succeed in instantaneously causing the uterus to contract by slapping the lower part of the abdomen smartly with a wetted towel.

Compression of the aorta through the abdominal walls is capable of rendering temporary service. The method has been objected to on theoretical grounds: first, because the compression is brought to bear equally upon the vena cava as upon the aorta; and, second, because the pressure does not cut off the blood which goes to the uterus through the aortic uterine arteries. As a clinical fact, however, it is indisputable that the pressure does, temporarily at least, check the hæmorrhage, a result attributed by Frankenhaeuser to the simultaneous stimulation of the aortic uterine plexus, as that portion of the sympathetic nerve is termed which overlies the large vessels of the trunk situated in the lumbar region.

The application of ice to the abdomen, or allowing a stream of cold water to fall from a height upon the hypogastrium, however efficacious they may prove as means of arresting hæmorrhage, are open to the

* Trans. Am. Gynæcol. Soc., vol. iii.

grave objection that they add to already existing shock and to the prostration produced by the loss of blood.

Methods of securing Uterine Retraction.—Uterine contractions afford only a temporary safeguard against hæmorrhage. It is uterine retraction that prevents recurrence. At first the hand furnishes the most available means of exercising external compression. It likewise possesses the advantage of being an intelligent instrument, capable of conveying to the accoucheur instant warning of any tendency to relaxation. But, even after retraction is secured, its maintenance should not be left to chance. Before leaving his patient, the physician should provide some means of subjecting the uterus to sustained and equable pressure. The usual method consists in surrounding the anteverted organ with folded napkins or rolled stockings, and then applying a bandage tightly to the abdomen to keep them in position. Unless skillfully executed, this method accomplishes little more than to dislocate the uterus laterally. I have been in the habit of using a round bag of rubber covered with brown muslin, which I partially fill with cold water, and apply over the uterus. The dry cold is of value as a means of exciting contraction, while the hydrostatic pressure is evenly distributed over the fundus of the uterus, and helps to fix it in the median line. A reliable compress may be improvised in any household by partially filling a sack with moistened sand or common salt.

More recently Dührssen * has advocated the packing of the uterine cavity with iodoform gauze. The method he pursues is as follows: When the uterus does not respond to kneading and an ergotin injection, he first, with the patient placed crosswise in bed, washes out the vagina and uterus with a three-per-cent solution of carbolic acid, then passes the fingers into the uterus to make sure that it is empty, and finally, with the cervix drawn to the vulva with volsella forceps, or under the guidance of two fingers passed to the cervix, a strip of iodoform gauze is pushed by means of uterine forceps to the fundus and cavity of the uterus until the latter is completely filled. The result is said to be the immediate arrest of hæmorrhage due to the intra-uterine compression, and the contraction of the uterine muscle. Dr. Polk has tried the method in the Bellevue Hospital, and has been favorably impressed with its efficacy. Dührssen advises that the packing be extended from the uterus to the vagina to control hæmorrhages due to lacerations, but in tears of the cervix as well as in those about the vulva, the practitioner will find the suture the safest, the simplest, and the most certain hæmostatic.

Treatment of Anæmia.—In consequence of excessive loss of blood, the surface of the body becomes blanched, cold, and bedewed with clammy perspiration; a feeling of muscular prostration is experienced,

* Dührssen, Ueber die Behandlung der Blutungen post-partum, Volkmann'sche Sammlung, No. 347.

with distress in the præcordial region; thirst follows the rapid absorption of serum from the parenchymatous organs to make good the loss of fluid in the blood-vessels; the pulse becomes small and frequent, the respiration rapid, and air-hunger is developed as the result of the deficient amount of oxygen carried by the attenuated blood-stream to the tissues and the medulla oblongata. With these general symptoms are associated special ones due to disturbances of the nerve-centers, as restless movements from side to side, yawning, vomiting, perversions of the special senses, fainting, and convulsions.

Now, it is to these latter symptoms, indicative of intense cerebral anæmia, and directly imperiling the life of the patient, that treatment requires to be especially addressed. The pillows should be withdrawn from the head, the foot of the bed should be raised, hot bottles should be placed to the extremities, and warm cloths to the head; if syncope occurs, the abdominal aorta should be compressed to reserve the entire blood-mass for the upper portion of the trunk and the brain; cerebral congestion should be promoted by opiates (thirty drops of laudanum by the mouth, or ten minims of Magendie's solution hypodermically injected), and the flagging heart should be stimulated by hypodermic injections of sulphuric ether, brandy, or whisky. The syringe should be filled with the agent chosen, and the injection should be made deep into the subcutaneous cellular tissue on the outer part of the thigh. The effect upon the circulation is almost instantly manifested. Except in cases which have passed beyond all possibility of recovery, the pulse reappears at the wrist, often, however, to fade away again in a few minutes. The stimulant injections in many cases require to be repeated a number of times before the circulation becomes re-established. So long, however, as there is a perceptible response to the stimulus, the case is never to be regarded as hopeless.

Dr. Gaspar Griswold has employed successfully in a number of cases, where the heart had apparently beat for the last time, intravenous injections of ammonia, using for the purpose a five-per-cent solution (the officinal solution diluted with equal parts of water), and injecting with a hypodermic syringe from fifteen drops to a half-drachm into one of the superficial veins of the forearm.

In the collapse resulting from excessive hæmorrhage, the restoration of blood to the circulation by transfusion is theoretically the rational mode of treatment. In practice, however, the difficulties of the *technique*, the hesitation of bystanders to furnish the required blood, combined with the somewhat unsatisfactory outcome of transfusion experiments, are all obstacles to its employment. More favorable results have, however, been obtained by substituting weak solutions of common salt for blood in cases where transfusion has been indicated. Although the saline solution can not replace blood, it has been proved to be a harmless agent, and capable of performing a useful part by so far restor-

ing the mechanical conditions of circulation as to furnish a basis for analeptic treatment. The transfusion apparatus needed is of the simplest character, viz.: A glass funnel, a piece of rubber tubing eighteen inches in length, and a canula of glass or metal for introduction into the vein selected. The strength of the solution employed should not exceed five to six grains to the pint (0·6 per cent to 0·75 per cent). Before operating the instruments, the utensils, and the solution should be thoroughly sterilized. The temperature of the solution should be from 100°–102°. The amount injected varies from a pint to a quart. The transfusion should take place slowly, under a pressure of from ten to eighteen inches. The ordinary time required is from fifteen to thirty minutes. When the process is ended a double ligature should be applied to the vein, and the wound should be covered with an antiseptic dressing.*

After the heart's action has once been established, the efforts of the physician should next be directed to the filling of the emptied vessels and the restoration of the arterial tension. With the restoration of the cardiac pulsations, the absorption from the stomach is very active and rapid. To avoid vomiting, however, it is necessary that fluids administered by the mouth should be given in small quantities and at brief intervals. I usually begin with either hot strong tea, without milk, or with brandy-and-water (1 : 2), at first a teaspoonful at a time, repeating the quantity every minute, then giving a tablespoonful of any warm liquid every five minutes, carefully testing the capacity of the stomach to dispose of its contents, withholding everything with the first premonition of nausea, until milk, broths, tea, gruel, and the like are found to be tolerated in ordinary quantities. Fluid nourishment should be continued hourly, with ice and water in the intervals, according to the thirst experienced, until the radial pulse is restored to its normal fullness. For the successful management of these cases it is necessary that the physician assume the entire charge. It is not possible to give directions to a nurse which may not at any moment require modification.

In cases of excessive loss of blood a tourniquet to each femoral artery, a roller bandage, or, better still, an Esmarch bandage applied the length of the lower extremities, may be temporarily employed with a view to saving the limited amount of blood in the circulation for the important organs of the trunk and for the nerve-centers.

Where the pulse is extremely rapid, the subcutaneous injection of one fiftieth of a grain of digitalin is reported to act favorably by causing contractions of the arterioles and of the uterus.

Opiates should be administered from time to time during convalescence, the frequency and quantity depending upon the intensity of the headache which acute anæmia induces.

* Otto Leichtenstern, Ueber Kochsalz infusion bei Verblutungen, Volkmann'sche, Sammlung, No. 25, Neue Folge, p. 253.

The Puerperal Hæmorrhages.—Hæmorrhages occurring after the first day following confinement are the result either of the separation of the thrombi from the placental site or of a congested condition of the endometrium.

Before the consolidation of the thrombi is completed, the mouths of single vessels may be opened by any sudden increase of pressure in the uterine vessels. A relaxed state of the uterus, obstacles to retraction, fecal accumulations, and malpositions of the uterus predispose to the occurrence of hæmorrhage. Common causes of late hæmorrhages are sitting up or leaving the bed at too early a period, exertions in caring for the infant, and straining at stool. In the case of a small, thin woman who flowed profusely in the second week, I found the utersu crowded backward and downward to the pelvic floor by the compress, which had been too tightly bandaged upon the abdomen by the indiscreet zeal of the nurse.

Where portions of the ovum have been allowed to remain behind in the uterus, they may lead to the formation of fibrinous polypi, which, as in the non-puerperal uterus, occasion a vascular condition of the mucous membrane, and become the cause of protracted bleeding.

The treatment of late hæmorrhages consists in rest in the horizontal position, in carefully regulated diet, in emptying both bladder and rectum, in the correction of displacements, and in the use of hot vaginal injections. In excessive anteversion a compress above the pubes is indicated; in retro-displacements, lifting the uterus into position, maintaining it in place by a suitable pessary, is often at once followed by relief. If other causes can be excluded the uterine cavity should be explored, and retained bodies, if found present, should be removed. When the cervix is patulous this can be accomplished by the finger; if the cervix is partially closed, or if inflammation be present, the wire curette, can be used, as after abortion, without preliminary dilatation. In curetting the uterus the operator should be mindful of the delicacy of the newly forming mucous membrane, and should feel carefully for the offending bodies. If the bleeding continues the uterine cavity may be tamponed with iodoform gauze.

Retained Placenta.

Retained placenta is so frequently a cause of hindered uterine retraction that a few words concerning the etiology and treatment of the condition form an appropriate appendix to the discussion of *post-partum* hæmorrhage.

Cases of so-called placental retention are often simply the result of injudicious management. Thus, they may be caused by pulling in such a way upon the cord as to draw the center of the placenta into the cervix, so that, without allowing air to pass by the placenta to the uterine cavity, extraction is rendered impossible; or, when Credé's

method is practiced, the operator may, by pressing the fundus forward against the pubes instead of downward in the axis of the pelvis, produce an acute anteflexion, with stenosis of the lower uterine canal.

True retention may be due to the large size of the placenta or to pathological adhesions, either of the placenta itself or of the chorion.

An adherent placenta is of rare occurrence, and can usually be traced to a bygone endometritis. Separation normally takes place in the areolar layer. If the glandular walls which constitute the septa of the areolæ consist of tough intercellular substance instead of soft tissue abundantly supplied with cells, the separation does not take place, and the placenta remains adherent. The thick bands which have to be severed in removing the placenta are in general the straight trunks of the villi, which run from the chorion to the serotina, the separation taking place not in the decidual but in the fetal layer. In placentitis the bands consist of thickened decidual tissue extending between the cotyledons. In either case the serotina is left nearly or quite entire; in some instances, owing to their firm attachment, whole lobules may be left behind.

Adhesions of the chorion may be due to thickening of the septa in the areolar layer; to defective involution of the cell-layer of the decidua, thickened portions of which in consequence remain attached to the separated chorion; to secondary adhesions from consolidated masses of fibrine, the remains of apoplectic effusions into the decidua; and, perhaps, to excessive development of villi upon portions of the smooth chorion, from which proceed thick bands which are firmly united to the decidua (Spiegelberg). Adhesions of the chorion interfere with the separation of the placenta only when situated high up or around the placental border.

The Artificial Separation of the Placenta.—Whenever compression of the uterus proves unavailing to procure the expulsion of the placenta, the operator should seek to aid the delivery by the resources of art. To leave the placenta within the uterus not only exposes the patient to the risks of hæmorrhage, but to the even greater danger of decomposition and of septic poisoning. A digital examination will indicate the proper course to be pursued. If the placenta be found covering the os, a finger should be introduced to bring down a placental border. If no adhesions exist, moderate tractions upon the cord will then suffice to deliver the placenta. Spiegelberg recommends using the vaginal finger as a pulley to cause the tractions upon the placenta to be made in a vertical direction.

If tractions upon the cord are insufficient, or if the cord begins to tear, the outer hand should make counter-pressure upon the fundus, while the fingers of the vaginal hand are passed upward into the uterine cavity. At first a point should be selected where the placenta is already partially detached, and the fingers should be employed to roll

the placenta away from the uterine wall. If the attachment of the placenta is firm, the fingers should be extended with the back of the hand to the uterus, and the separation attempted by a side-to-side movement, as in cutting the leaves of a book. Contractions are here of great service, as they both facilitate the separation and serve to render distinct the border-line between the placenta and the uterus. Hildebrandt advises following the cord upward and separating the placenta with the hand covered by the membranes, as a means of avoiding the dangers of infection and of injuring the internal uterine surface. Spiegelberg says that in his experience this method has succeeded only where the placental attachment was loose and the separation easy.

Bands should be divided by pressing them between the thumb-nail and the index-finger. When the placenta is situated upon the anterior wall, the patient should be placed upon the side. When the placenta is everywhere adherent, a thickened border should be chosen as the point for commencing the detachment. In a very thin, diffused placenta, it has been proposed by Hohl to inject the vessels through the umbilical vein.

The operation of separating the placenta should never be performed hurriedly. Every pains should be taken to avoid injuring the uterine surface, and as little placental tissue as possible should be left behind.

When the detachment of the placenta is completed, it should be grasped from above in the full hand, and its expulsion should be effected by external pressure. If portions of the membranes are torn away during delivery, they should be sought for and carefully removed.

In every case of artificial placental delivery the cavity of the uterus should subsequently be thoroughly irrigated with warm carbolized water.

CHAPTER XXXII.

PLACENTA PRÆVIA.—ACCIDENTAL HÆMORRHAGE.—INVERSION OF THE UTERUS.

Situation.—Varieties.—Frequency.—Causes of hæmorrhage.—Clinical features.—Prognosis.—Diagnosis.—Treatment.—Accidental hæmorrhage.—Inversion of the uterus.

Situation.—Normally the placenta, as we know, is situated at the fundus and upon the side walls of the uterus. It is said to be *prævia* when it occupies that portion of the uterus which is subject to distention during labor, or, in other words, to the spherical surface of the

lower portion of the uterus. Its clinical importance is proportioned to the extent of the placental segment which overlaps the os internum. Hence it is customary to distinguish—

Varieties.—1. *Placenta prævia centralis*, where, after the dilatation of the os internum has become complete, the placenta only can be felt.

2. *Placenta prævia partialis*, where, with dilated os, there is recognizable a portion of the membranes, as well as a segment of the placenta.

3. *Placenta prævia lateralis*, or *marginalis*, where the placental border stretches down to, but not beyond, the margin of the inner cervical ring.

Observations which tend to prove the attachment of the placenta in part to the cervical mucous membrane are unquestionably erroneous. The fact, first stubbornly insisted upon by Professor I. E. Taylor, has, at least among physiologists, passed beyond the realm of dispute. Kuhn,* who investigated the subject in conjunction with Carl Braun, found that in no case was the placental portion which occupied the cervical canal adherent to the canal-walls, but that in all *post-mortem* examinations the remains of the placenta prævia materna ended by a sharp border-line at the os internum.

An exact central implantation of the placenta is extremely rare, though its occurrence is not impossible. Usually in the so-called central form not more than one sixth to one fourth of the placental surface overlaps the os internum. The smaller segment is oftener found upon the left side (37 : 56, statistics of L. Müller).†

Owing to the deficient thickness of the decidua in the vicinity of the internal os, the placental villi grow with less profusion at that point, while by way of compensation in more favored localities they attain to an excessive development. The placenta thus assumes a characteristic uneven appearance. If the atrophic conditions exist over a wide extent, the surface of the placenta is, as a rule, correspondingly increased.

Another peculiarity not devoid of practical interest is the frequency with which the placenta is found adherent to the uterine walls. Of 142 cases, L. Müller showed that in 56 adhesions existed. The insertion of the cord into the placenta is usually eccentric, often marginal, and sometimes velamentous. As a consequence, prolapsed funis is a common accompaniment of the anomaly.

Fortunately, placenta prævia is of rare occurrence. Müller, by adding together the statistics of various investigators, found reported 813

* Braun, Lehrbuch der ges. Gynaek., p. 555.

† Ludwig Müller, Placenta Prævia, Stuttgart, 1877. Most of my statistics are taken from this work. They include those of Trask (Am. Jour. of the Med. Sci., 1856, vol. viii) and of most of the later writers, up to date of publication.

instances in 876,432 births, or not quite one case in a thousand. Since the opening of the Emergency Hospital in this city there have been between 1,500 and 1,600 women confined in that institution. So far there has been no case of placenta prævia. Lomer,* on the other hand, estimates the minimum frequency in Berlin at one in 723 births.

Etiology.—The causes are unknown. The proportion of multiparæ to primiparæ is very large (6 : 1).† Placenta prævia is most frequent in women who have borne children with great rapidity, and in pregnancies shortly following abortions, conditions which favor relaxation of the uterine walls, dilatation of the cavity, and defective development of the decidua. Müller advances the theory that the descent of the ovum is effected by contractions of the uterus soon after conception. Such expulsive pains naturally lead to abortion. In certain cases, however, where the reflexa is absent, we have seen that the ovum may be forced downward into the cervical canal, and lingering there may give rise to "cervical pregnancy." Placenta prævia Müller believes to be due to an abortion begun at an early period, but arrested at the lower uterine segment to which the villi attach themselves, and enable the rescued ovum to continue its development. Ingleby relates two curious cases where the orifices of the Fallopian tubes opened near the os internum, in one of which placenta prævia occurred three times, and in the other ten times.

Clinical Features.—The chief clinical importance of placenta prævia results from the mode of its detachment during labor. In normal positions the separation of the placenta is effected by virtue of the uterine contractions after the fœtus has for the most part been expelled. In placenta prævia the separation is due to the stretching to which the lower uterine zone is subjected in its conversion from a half-sphere to a cylindrical canal, to permit the passage of the child. The extent of unavoidable separation in advance of delivery is consequently measured by the dimensions of the child's head, the largest circumference of which is estimated as equivalent to a circle with a diameter of four and a half inches. According to Duncan, the plane at which spontaneous detachment ceases is reached at a distance of two and a half inches by following the curve of the lower segment, and of one inch and a half if measured in the direction of the uterine axis. Whereas, in normal labor, the contractions of the uterus which determine placental separation close at the same time the orifices of the torn vessels, the stretching of the lower segment in placenta prævia leaves the mouths of the sinuses gaping, from which the blood pours until the

* Lomer, Combined Turning in the Treatment of Placenta Prævia, Am. Jour. of Obstet., December, 1884, p. 248.

† Müller collected from different reporters 1,574 cases—227 of primiparæ and 1,347 of multiparæ. Jüdell reports the multiparæ at 90 per cent. King (Am. Jour. of Obstet., October, 1880, p. 751) reports 183 cases collected in the State of Indiana, in which the proportion was 20 primiparæ to 163 multiparæ.

stream is arrested either by art or by the supervention of syncope. As the hæmorrhage in such cases is the natural sequence of cervical dilatation, its occurrence during labor was termed by Rigby "unavoidable" in contradistinction to hæmorrhages from detachment of the placenta when situated near the fundus, where the separation is attributable to "accidental" causes.

Fig. 225.—Diagram showing the unavoidable placental separation as a consequence of cervical dilatation.

The hæmorrhages of placenta prævia are not, however, limited to the parturient period. Indeed, there is no time in pregnancy when they may not occur. When we consider that every jar of the body affects the lower segment with more force than the fundus, and that the thinned walls of the uteroplacental vessels are subject to increased pressure in placental presentations, it becomes evident that a very slight occasion is sufficient to produce rupture and hæmorrhage. Thus placenta prævia is a common cause of the pseudo-menstruation of pregnancy; it creates a predisposition to abortion, and, later in gestation, to premature labor, the hæmorrhages being due probably in the first instance to accidental causes and not to labor-pains. Not every case of hæmorrhage is, however, followed by labor. Indeed, in many instances thrombi form in the open vessels, the bleeding becomes arrested, and pregnancy goes on for a time undisturbed. The tables of Müller show that in complete placenta prævia the first hæmorrhage occurs with the greatest frequency between the twenty-eighth and thirty-sixth weeks, while in the incomplete form it takes place most commonly after the thirty-second week. In placenta prævia lateralis, hæmorrhages are sometimes absent up to the time of labor. Cases of pregnancy, and in part of labor, without hæmorrhage have been observed where the death of the fœtus has been followed by atrophic changes in the placenta. The recurrence of hæmorrhage is oftentimes prevented by secondary shrinkage of the placenta, due to pressure from the effused blood or to thrombosis of the vessels which supply the implicated cotyledons.

The hæmorrhages of placenta prævia are usually sudden without premonitory warnings, without pain, often without any apparent occasion, sometimes occurring at the time of urination, sometimes during sleep. The quantity of blood lost in a single hæmorrhage depends upon the extent of the placental separation. The first outpouring may

lead to intense anæmia, and if repeated at a short interval may cause death. It is estimated that from one to three pounds of blood may be lost in a single attack, and from four to five pounds in the course of labor (Müller). As a rule, however, the hæmorrhages of pregnancy are at first moderate in character, increasing in violence with each repetition. A very formidable variety is the so-called "stillicidium," where the blood issues drop by drop for days and even weeks in succession. The most violent hæmorrhages occur generally in the earlier part of the first stage of labor. As a rule, the extent of the hæmorrhage is proportioned to the area of the placental segment attached to the uterine surface subject to distention. The hæmorrhage generally ceases when the separation of the cotyledons is completed and, after the rupture of the membranes, the pressure of the presenting part is brought to bear upon the bleeding surface. During the height of the pains, too, the hæmorrhage is for the moment arrested (Spiegelberg).*

The number of abnormal presentations in placenta prævia is very large. Thus, in Müller's statistics, in 1,148 cases there were 272 transverse and 107 breech presentations. The frequency of the anomalies is partly attributable to the large proportion of premature labors, and partly to the width and lax condition of the lower segment, and the consequent want of stability in the fœtus.

During the first stage of labor the pains are apt to be feeble and the dilatation tardy. The causes of inertia are to be found in the thinning of the muscular structures in the lower segment from the enormous development of the utero-placental vessels; in the attachment of the placenta over the os, which mechanically hinders dilatation; and in the fact that the ovum does not press directly upon the sensitive nerves of the cervix. Secondary weakness often follows the continued losses of blood and the prolongation of the first stage. When the obstacle afforded by the placenta to dilatation has been overcome, and, consecutive to rupture of the membranes, the uterus retracts, in many cases the scene speedily changes, and, in place of ineffective contractions, normal and often powerful pains develop.

As a rule, quite early in labor the cervix is found soft and dilatable; but to this rule there are numerous exceptions. Strictures and rigidity Müller computes to exist in about twelve per cent of the cases.

Where the loss of blood in labor is continuous the woman grows restless and complains of headache and vertigo; the respirations become short, interrupted, and sighing, and the pulse small, weak, and thready. Toward the close unconsciousness develops, the brow is bedewed with

* This view was first advanced by Fountain in the Am. Jour. of the Med. Sci. It has since been advocated by Duncan, Jüdell, Fränkel, Spiegelberg, and others. Müller and Kuhn, however, dispute it, as justified neither by theory nor by observation.

cold, clammy perspiration, and finally convulsions usher in the fatal termination.

Even after labor is over the danger is not ended. *Post-partum* hæmorrhage may result from atony of the placental surface of the uterus, or, after good contractions have been apparently secured, sudden relaxation may follow, and the blood pour out in a torrent, so that the patient becomes a corpse before assistance can be rendered. Again, in childbed the imperfect contraction of the uterus at times allows the lochia to form a stagnant pool at the fundus, whence an ichorous discharge flows constantly downward over the thinned walls and open mouths of the vessels at the placental wound. The feeble circulation predisposes to the formation of thrombi, which, when poisoned and disintegrated, are conveyed into the general circulation and give rise to the dreaded symptoms of pyæmia. Müller found in two hundred and seventy-three of his cases specific information given regarding the puerperal state. "Puerperal fever" was recorded of seventy-nine patients, with fifty-four deaths.

Prognosis.—The prognosis of placenta prævia is necessarily extremely unfavorable. As many as one mother in four dies during or shortly after delivery. Including deaths from puerperal processes, Müller estimates the total mortality at not less than from thirty-six to forty per cent. Nearly two out of three of the children are born dead. More than one half of those born living die within the first ten days. In general terms it may be stated that the prognosis is the more serious the earlier the hæmorrhages begin in pregnancy, the more profuse the flow, and the shorter the intervals between the attacks. During labor favorable conditions are a vertex presentation, good pains, rapid dilatation, and an unbroken constitution. The maternal mortality is twice as great in placenta prævia centralis as in placenta prævia lateralis. In the city there is the special danger of infection; in the country, of delay in obtaining medical assistance. Finally, it is impossible to analyze the statistics of placenta prævia without coming to the conclusion that the result depends in a large measure upon the personal qualities of the physician. A self-possessed man, cool, resolute, with clear ideas of the anatomical conditions to be dealt with, will, if summoned in season, apparently deprive even placenta prævia of a good share of its terrors.

Diagnosis.—There are no signs by which placenta prævia can be recognized in the first half of pregnancy. It may occasion abortion, which is then characterized by the absence of pain, both previous to the hæmorrhage and during the period of expulsion. As a rule, the ovum is expelled entire without rupture of the membranes. In the second half of pregnancy, a hæmorrhage occurring suddenly, without ostensible cause and without warning, should always be regarded with suspicion. Upon digital exploration in placenta prævia the vaginal

fornix is found soft and boggy, and occasionally thicker upon the one side than upon the other, where the placental presentation is incomplete; ballottement is obscure; the cervix is long, wide, and soft, and contains at times vessels which pulsate distinctly; the cervical canal permits the passage of the finger to the os internum, which at first offers resistance, but yields to gentle force. The diagnosis is rendered positive only in cases where the lower surface of the placenta is actually felt through the cervix, its rough, spongy, granular texture sufficiently distinguishing it from clots and other possible sources of deception.

Treatment.—The history of placenta prævia brings into prominence the central point to be kept steadily in view in practice, that there is no safety for the mother so long as pregnancy continues. In a very large proportion of cases, accidental hæmorrhage occurring in the first half of pregnancy leads to abortion, the management of which does not differ from that of abortions which take place in normal attachments of the placenta. Of the one hundred and twenty-eight deaths from placenta prævia collected by Müller, not one occurred previous to the seventh month. In the latter half of pregnancy, hæmorrhage likewise leads to premature expulsion of the ovum with such frequency that it is reckoned that only one third of all cases reach the end of gestation.

Most authorities advise, in the presence of the hæmorrhages of advanced pregnancy, that the physician maintain an attitude of expectancy, postponing active interference, except in cases where the loss of blood assumes alarming proportions, until the spontaneous advent of labor. This policy is recommended partly in the interest of the child, and partly because of the tendency in premature labor to rigidity of the cervix, a complication which always in placenta prævia enhances the risks of delivery. The wisdom of delay is, however, open to serious question. The fatality of placenta prævia is due not so much to the impotence of obstetrical art as to the losses of blood which occur suddenly in the absence of professional assistance. The first hæmorrhage, which serves as a warning as to the patient's condition, is fortunately in most instances slight. With each recurrence, however, the flow becomes more profuse. If the hæmorrhages begin before the child is viable, the chances of saving its life are in any event too small to offset for a moment the welfare of the mother. Hæmorrhages occurring as early as the seventh month are, as a rule, the result of complete placental presentation. To trifle with such cases is the best way to maintain the present mournful statistics. After the thirty-second week it is safe to say that the child's life is less imperiled by the induction of premature labor than by exposing it to the dangers of continued gestation.

On theoretical grounds, therefore, the induction of premature labor is to be regarded as obligatory so soon as the diagnosis of placenta

prævia is established, or at least with the occurrence of the first hæmorrhage. The practical results of this measure in the hands of its advocates * plead still more effectively in its behalf. Thus, Dr. Gaillard Thomas † reports eleven cases, with but two deaths, one resulting from *post-partum* hæmorrhage coming on several hours after delivery, and one from puerperal fever. Hecker ‡ lost three cases in forty, Hoffmann two cases in thirty, and Spiegelberg four cases in seventy-four early deliveries.* More recently Murphy ‖ has reported fifteen cases without a single death. In this connection I can not help quoting the following impressive remarks of Dr. Barnes: "If the pregnancy have advanced beyond the seventh month it will, as a general rule, I think, be wise to proceed to delivery, for the next hæmorrhage may be fatal; we can not tell the time or extent of its occurrence, and, when it occurs, all, perhaps, that we shall have the opportunity of doing will be to regret that we did not act when we had the chance."

In the management of placenta prævia it is very desirable that the practitioner should have a perfectly clear idea of the nature of the task he has to perform. The birth of the child can not take place without preliminary expansion of the cervix. The cervix can not expand without detachment of the placenta. The principal objective point of treatment, therefore, is the hæmorrhage which occurs during the stage of dilatation. Plans for restricting the flow within narrow limits have been proposed without number by masters of the obstetric art. The best plans are those which at the same time contribute to shorten labor. The choice must be determined by conditions which necessarily vary in different cases. The physician has at the outset to particularly inform himself as to whether labor has begun or remains to be inaugurated, as to whether the placenta prævia is complete or incomplete, as to whether the presentation is normal and the pains are good, as to whether the membranes have ruptured or are intact, and as to the length and dilatability of the cervix.

If the cervix is long, narrow, and rigid, and the membranes are entire, the vaginal tampon should be resorted to as a temporary expedient. The tampon strengthens the pains, and, by the compression it exerts, causes coagulation of the blood which escapes from the uterine vessels. Professor I. E. Taylor advises packing the vagina with a surgical bandage, leaving one end outside the vulva, by means of which it can be withdrawn without difficulty. Braun, after many years' ex-

* Premature labor in profuse or continuous hæmorrhage has received the indorsement in this country of Thomas, Taylor, Parvin, Pallen, and Taber Johnson.

† Trans. of the N. Y. Obstet. Soc., vol. i, p. 262.

‡ Statistics taken from L. Müller's monograph.

* Spiegelberg's statistics do not, however, like those quoted from Thomas, include deaths in childbed. Thus, Spiegelberg's complete death-rate reached sixteen per cent.

‖ Murphy, Brit. Med. Jour., 1884, p. 215.

perience at Vienna with the colpeurynter, maintains the superiority of hydrostatic dilatation. I use cotton, made into disks, and dampened in a two-per-cent solution of carbolic acid, crowding it into the upper portion of the vagina with the aid of a Sims speculum. The choice does not appear to be material if due attention be paid to the carrying out of aseptic details. Having once introduced the tampon, the physician should not leave his patient until the labor is ended. After at most four hours the tampon should be removed, and, after rendering the vagina thoroughly aseptic, the cervix should be examined. A second introduction of the tampon is rarely necessary, or, owing to the dangers of septic infection, expedient.

So soon as the os will permit the passage of the finger, the vaginal plug should be discarded. The operator will then have to choose between one of two plans of action, viz., dilatation of the cervix by means of water-bags, or version by Braxton Hicks's method. If dilatation is decided upon, a Barnes rubber bag, expanded sufficiently to render the border of the os externum tense, fulfills admirably the principal indications. It acts as an efficient tampon, it strengthens the pains, and it dilates the cervical canal. As the latter expands, a larger-sized dilator should be introduced. It is important, in order to prevent hæmorrhage, to maintain the tension of the external orifice. On account of the softening which exists in the lower uterine segment as a result of placenta prævia, in a large proportion of cases the cervix can be stretched with the utmost facility. If no urgent symptoms call for immediate interference, it is desirable to render the dilatation complete. It is not, however, always necessary. Indeed, Barnes, Taylor, Spiegelberg, and Braun advise to proceed boldly with the delivery so soon as the os externum has expanded to the size of a half-dollar, as by that time the expansion of the os internum is very nearly completed, and as the soft cervical canal does not offer sufficient resistance to materially interfere with the extraction of the child. The distinguished success of the authorities mentioned in the field of practice under consideration lends great weight to their recommendations. It is, however, more than probable that exceptional training and experience count in their case for quite as much as the plans of procedure they individually favor. At any rate, in reviewing the statistics of Trask and Müller it becomes evident that rigidity of the cervix is not a rare event in placenta prævia, and that the *accouchement forcé*, performed with a rigid cervical canal, is perhaps, next to doing nothing, the most responsible cause of the mournful results they have placed on record.

Jungbluth (Die Behandlung der placenta prævia, Volkmannsche Sammlung, No. 235), advocates the use of large sponge tents, rendered aseptic by careful preparation, (*vide* p. 360), in placenta prævia. He claims in their favor that they cause active uterine contractions, and act as an efficient tampon, so

that complete dilatation of the cervix can be secured without loss of blood. He directs that the attendant shall first ascertain the direction and width of the cervix and the distance of the os externum from the placenta. He then selects a tent to correspond. With a sharp knife the tent should be cut across so that when introduced its length shall not exceed that of the canal by more than an inch. The abtruncated tent is to be seized in ovum forceps, the cut end is to be dipped for a moment in hot water, and then, under the guidance of two fingers in the vagina and with counterpressure from above, the tent is to be pushed up the canal to the placenta, and held in place for ten to fifteen minutes, by which time the expansion is sufficient to tampon the lower uterine segment. Jungbluth claims that if at the outset the external parts, the vagina, the instruments, and the hands of the operator are surgically clean, the tent after its introduction may be left eight or ten hours *in situ* without the slightest risk of sepsis.

Sometimes one, sometimes as many as three or four, sponge cylinders are requisite. If unfilled spaces are left, small tents should be inserted to secure a complete tamponing effect. In no case should a vaginal tampon be used. A compress to the vulva will show if any leakage occurs. In that case it is an indication that the tents have been faultily placed. They should then be removed, and new ones should be introduced. A renewal of the tents is likewise required when, as the cervix softens and dilates, the finger can be pushed at the border upward to the placenta. The vagina should be then washed with carbolic-acid solution (two per cent), the hands disinfected, and the sponges withdrawn by a leverage movement. In the partially expanded cervix three or four cylinders tied together should be introduced and held in place in the manner already described. A third renewal is rarely necessary. In answer to the objection that the method is troublesome, Jungbluth argues that trouble is of small consideration when life is at stake.

After the cervix has been duly prepared the membranes should be ruptured, and a part of the amniotic fluid should be permitted to escape. Then, if the placenta possesses a lateral or a marginal attachment, if the pelvis is of normal size and the pains strong and regular, and if the head present, or at least can be brought down and fixed at the pelvic brim by external manipulations, the further progress of the case may be left to Nature. Hæmorrhage will then be prevented by the pressure of the fœtus in its descent through the utero-vaginal canal. At first the method of expression advocated by Kristeller is capable of rendering important service by promoting the speedy engagement of the child's head. Ergot, too, cautiously administered, is useful in strengthening the uterine contractions. Even if tonic contraction follow from its employment—an unlikely event in placenta prævia—the effect would be to close the sinuses and to furnish a fresh barrier against hæmorrhage. The forceps may be applied under the same circumstances, and with the same restrictions, as in other conditions. Where, however, the head is movable, the patient anæmic, and hæmorrhage persistent, version, as furnishing the more rapid mode of delivery, would receive the preference.

In cases of complete attachment of the placenta there should be no trifling with half-way measures. If the cervix is long and rigid, the vaginal tampon should be employed as a preliminary measure. When the cervical tissues have become softened, and dilatation has begun, the tampon should be removed. At this stage Barnes recommends separating at once that portion of the placenta which is attached above the inner orifice of the cervix. By so doing, "we remove an obstacle to the dilatation of the cervix, for the adherent placenta acts as an impediment." The operation is performed as follows: "Pass one or two fingers, as far as they will go, through the os uteri, the hand being passed into the vagina if necessary; feeling the placenta, insinuate the finger between it and the uterine wall; sweep the finger around in a circle, so as to separate the placenta as far as the finger can reach. . . . Commonly some amount of retraction of the cervix takes place after this operation, and often the hæmorrhage ceases." * Next put in a Barnes dilator and rapidly expand the cervix. Meantime try and bring the breech down into the lower uterine segment by external palpation. Both Taylor and Braun have found external version easy, on account of the inert conditions of the uterine walls. When the cervix has been sufficiently stretched to admit of delivery, two fingers should be introduced, the placenta should be separated, the membranes ruptured, and an extremity should be seized without passing the entire hand into the uterus. Extraction should then follow, the pressure of the fœtus preventing any considerable amount of hæmorrhage.

Usually the right hand is chosen to seek the feet, as the placenta more frequently overlaps the left side. Often a hint is furnished by the fact that the overlapping portion of the placenta is separated to a greater extent than the main body. Many times, however, it will be necessary to change the direction of the fingers before the edge of the placenta is reached. If external version can not be effected, the operator should push the hand forward into the uterus to find an extremity. The arm acts during the search as a temporary tampon. Hæmorrhage, which follows the withdrawal of the arm, will be arrested by the descent of the breech.

The accidental rupture of the membranes before the cervix is prepared for artificial delivery is hardly likely to occur in cases of placenta prævia completa. In cases of marginal implantation, dilatation with water-bags should be employed in such a way as to compress the open sinuses from which bleeding takes place.

* Barnes, Obstetrical Operations, p. 503. The artificial separation of the placenta is unquestionably of service where it can be accomplished without difficulty. Much time should not, however, be lost in fruitless efforts, nor is it desirable to persist if the separation can not be accomplished smoothly. Behm, Hofmeier, and Lomer all urge in such cases passing the fingers directly through the placental tissue. The most alarming hæmorrhage ceases when the leg is brought down.

In 1861 Braxton Hicks recommended for the treatment of placenta prævia turning the child by the two-finger method in an early stage of labor, and, after rupture of the membranes, bringing down the breech to tampon the bleeding vessels. This practice has been followed with distinguished success by Hofmeier* and Behm† and in the University Hospital for Women, in Berlin. The cases reported from the latter institution by Lomer‡ were 101, operated upon by nine different assistants, with a total of 7 deaths. Hofmeier reported 37 cases with 1 death, and Behm 35 cases with no maternal death. Thus, in 178 cases occurring in the practice of 11 individuals, there were 8 deaths, a mortality of but 4·5 per cent. But Lomer had no death in 16 cases. The addition of these latter to those of Hofmeier and Behm gives in the practice of three individuals only 1 death in 93. To be sure, the life of the child is made, by this premature version, a secondary consideration. Hofmeier reports an infantile mortality of 67 per cent, that of Behm was 80 per cent, while in Lomer's report the fetal death-rate was only 50 per cent. However, many of the reported deaths were in non-viable children, or were cases where the death of the child occurred long prior to birth. Hofmeier advocates following up version by the slow extraction of the child. By this means he has succeeded in ending labor in the course of from half an hour to one hour and three quarters. Behm counsels awaiting the spontaneous expulsion of the child, or at least the complete dilatation of the cervix. Lomer says: "In our cases we exert gentle tractions now and then, until the cervix is completely dilated, and we then slowly increase the number and strength of the tractions." Lomer sums up the advantage of the method as follows: 1. It does away with the tampon, and the consequent dangers of infection. 2. It allows us to operate early. 3. It arrests hæmorrhage with great certainty. 4. It gives time for the patient to rally, for the cervix to dilate, and for pains to set in. It therefore prevents *post-partum* hæmorrhage. I have recently had occasion to test this plan in a case of placenta prævia completa, and am prepared to speak most strongly in its favor, as both mother and child were saved, though I still believe that a certain amount of preliminary dilatation with Barnes's bags tends to enhance the chances of the child without endangering the life of the mother.

After the birth of the child, the danger of *post-partum* hæmorrhage must be kept in mind. Every preparation should be made in anticipation of its occurrence. If bleeding persists after the fundus is felt to

* Hofmeier, Zur Behandlung der Placenta Prævia, Ztschr. f. Geburtsh. und Gynaek., vol. vii, p. 89.

† Behm, Die combinirte Wendung bei Placenta Prævia, Ztschr. f. Geburtsh. und Gynaek., vol. ix, p. 373.

‡ Lomer, Combined Turning in the Treatment of Placenta Prævia, Am. Jour. of Obstet., December, 1884, p. 1233.

be firmly contracted, a speculum should be introduced, and the open sinuses of the lower segment should be swabbed with cotton soaked in some styptic form of iron, as recommended by Engelmann (*vide* Post-Partum Hæmorrhage). Ergot should be given for several days, as the danger of late hæmorrhages is specially great following placenta prævia.

The utmost cleanliness and the use of disinfectant vaginal douches must be insisted on during the childbed period, as the exposure of the placental wound to the lochia, which constantly flow over it, renders the patient especially liable to septic infection.

Hæmorrhage from Normally Implanted Placenta.—The placenta, even when implanted over the upper polar circle, the safe placental seat of Dr. Barnes, may become detached to a greater or less extent during pregnancy or labor, and may then furnish a flow of blood that either remains internal and concealed or may find its way between the decidua vera and reflexa, and thus escape into the vagina.

The hæmorrhages from this variety of placental separation are termed "accidental," in contradistinction to the "unavoidable" form, which is the accompaniment of placenta prævia.

The circumstances under which concealed hæmorrhage takes place are given by Goodell* as follows: (*a*) When the placenta is centrally detached, and the blood accumulates in the *cul-de-sac* formed by the firm adhesion of its margins to the uterine wall. (*b*) When the placenta is so detached that the blood escapes into the uterine cavity behind the membranes near the fundus. (*c*) When membranes are ruptured near the detached placenta and the effused blood mingles with the liquor amnii. (*d*) When the presenting part of the fœtus so accurately plugs up the maternal outlet that no existing hæmorrhage can escape externally.

The causes of internal hæmorrhage, when such can be determined, are for the most part similar to those considered in connection with abortion. Thus, the circumstances leading to placental detachment Goodell found to be irregular uterine contractions, external violence, and undue exertion; in seven the causes were purely emotional, and ten took place during sleep. It occurs more frequently in multiparæ and in the latter months of pregnancy.

The symptoms are an alarming state of collapse, pain often excessive, absence or extreme feebleness of the pains of labor, marked distention of the uterus, sometimes a lateral bulging of the uterine walls, a show of blood, a serous discharge, and blood in the liquor amnii.

The diagnosis in the concealed form may be extremely embarrassing. The pain is often that of flatulent colic. The accident likewise

* Goodell, On Concealed Accidental Hæmorrhage of the Gravid Uterus (Am. Jour. of Obstet., August, 1869, p. 281). This paper serves as a mine from which most subsequent writers have drawn their data.

presents many features which resemble those of ruptured uterus; but rupture, by contrast, rarely occurs until after the escape of the waters, the presenting part then receding from the os, and the uterus diminishing in size.

The prognosis is very unfavorable. Goodell reports: "Out of one hundred and six tabulated cases, fifty-four mothers perished; and out of one hundred and seven children, six alone are known to have been saved." I have had a case since his paper, where, after labor, I removed at least a basinful of firm clots from the uterine cavity, and yet both mother and child survived.

In cases of external hæmorrhage the diagnosis is easy and the prognosis more favorable, the latter probably because the walls are less flaccid than in the concealed form.

The treatment consists in the subcutaneous injections of ergot, in dilatation of the os with Barnes dilators, in rupture of the membranes, and in version.

In my own case, to which I have referred, the Barnes dilator acted capitally, not only enabling me to expand the cervix, but exciting the uterus to contract vigorously. The serious symptoms set in after the membranes were ruptured, and compelled me to deliver with forceps. In another case I should certainly first dilate, and, after rupture of the membranes, should choose version and speedy extraction, and should avail myself of a skilled assistant, whose duty it should be to compress the uterine walls externally during the act of delivery.

Inversio Uteri.—Inversion of the uterus is a rare occurrence. Braun states that, of two hundred and fifty thousand births in the clinics respectively under the charge of Spaeth and himself, not a single complete inversion has come to their notice. There was one case in one hundred and ninety thousand confinements at the Rotunda Hospital in Dublin.

The production of inversion is favored by a large, relaxed uterus, the result of overdistention, of rapid delivery, or of hæmorrhage. The immediate cause may be either pressure exerted from above or traction from below. The first may proceed from straining efforts, especially in a sitting or kneeling position, or from attempts at placental expulsion before uterine contractions have been secured; the second may proceed from a short or coiled cord during expulsion, from tractions upon the cord after the child is born, or simply from the weight of the placenta. Hennig* concludes that the attachment of the placenta to the fundus, instead of a more lateral implantation, is an active cause of the accident.

Inversion may be partial or complete. In the former the fundus presents a saucer- or cup-like depression; in the latter the entire

* Hennig, Ueber die Ursachen der spontanen Inversio Uteri, Arch. f. Gynaek., Bd. vii, p. 491.

fundus descends into the vagina; in extreme instances the cervix may be inverted to the vaginal attachment. Dr. I. E. Taylor maintains a mechanism for a certain number of cases, which consists in a rolling out of the cervix, with gradual implication of the body and fundus.

The symptoms of inversion are shock and hæmorrhage. The shock is evidenced by the small pulse, cold extremities, vomiting, and sunken features, and is due, in part at least, to the sudden diminution of the intra-abdominal pressure and consequent plethora of the abdominal veins; the hæmorrhage results from imperfect contraction, and is therefore proportioned to the extent of the uterine paresis.

Spontaneous reduction of incomplete inversion is not uncommon. Cases of spontaneous reduction of the complete form have likewise been observed, referable, according to Spiegelberg,* to retraction of the ligaments acting upon the uterus while in a relaxed condition.

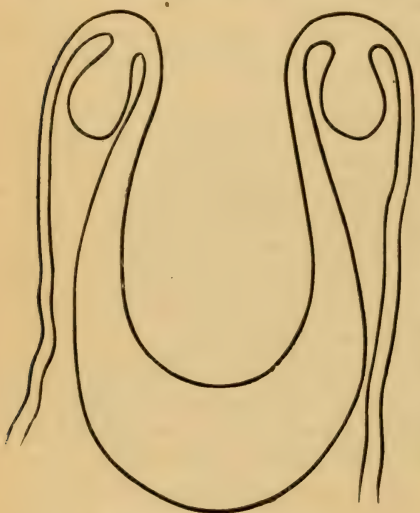


Fig. 226.—Inversion of uterus.

The diagnosis is not difficult. The inverted uterus can only be mistaken for a fibrous polypus, but by careful external and bimanual palpation the demonstration of the absence of the uterine tumor above the symphysis would guard against this error.

The prognosis depends upon the promptitude of the operator in restoring the fundus to its normal position. Still, according to Crosse's† statistics, one third of the patients died either at once or within a month of the occurrence of the accident.

Treatment consists in pressing the fundus upward with the fingers or with the closed fist. To avoid tearing the uterus from its vaginal attachments, care should be taken to employ counter-pressure with the disengaged hand upon the upper border of the funnel-shaped depression. If the placenta is detached to any great extent, its separation should be completed before replacement; if adherent, no time should be lost, but placenta and fundus should be pushed back together. If the cervix is contracted about the inverted portion, an anæsthetic should be given, and taxis should be employed. I can speak from ex-

* Spiegelberg, Lehrbuch, etc., p. 597.

† Crosse, An Essay, Literary and Practical, on Inversio Uteri, Trans. of the Provincial Med. and Surg. Assoc., 1847, p. 344.

perience in favor of Noeggerath's method, which consists in indenting the uterus in the neighborhood of a Fallopian tube, in place of acting directly upon the fundus.

In a case seen by me in conjunction with Dr. Henry E. Crampton, of New York city, thirty-six hours after delivery, I succeeded, after several fruitless efforts, in restoring the uterus by the following method: First, the fundus was pressed upward through the cervical ring by the thumb and fingers. The partially reinverted uterus was clearly felt through the thin abdominal parietes, but it was found impossible to

FIG. 227.—First stage of replacement.

FIG. 228.—Second stage of replacement.

advance the hand through the ring beyond the knuckles. The hand was therefore held steadily in place, with no attempt at a forward movement, for about ten minutes. This was done with the intent to procure a relaxation of the constriction by means of continuous pressure. Then the thumb was withdrawn, and the circular uterine fold, which still hung deep into the vagina, was pressed up on one side by the fork formed by the thumb and index-finger. Finally, by indenting the raised fold by the thumb, and at the same time making counter-pressure upon the uterine ring through the abdominal walls, I was enabled to push the entire mass by the ring, and had the pleasure of feeling the remainder of the inverted organ roll spontaneously into posi-

tion. The diagrams drawn for me by my friend, Dr. L. M. Yale, will help to make intelligible the mechanism of the manœuvre.

If the reinversion proves successful, the hand should be allowed to remain within the uterus, and external pressure should be employed until contraction is secured. The subsequent treatment does not differ from that for uterine atony, already considered in connection with *post-partum* hæmorrhage.

CHAPTER XXXIII.

RUPTURES OF THE GENITAL CANAL.

Rupture of the uterus.—Etiology.—Pathological anatomy.—Symptoms and diagnosis.—Treatment.—Prophylaxis.—Treatment after rupture.—Rupture limited to the peritoneal covering of the uterus.—Perforation from pressure.—Lacerations of the vaginal portion.—Laceration of the vagina.—Laceration of the vulva.—Thrombus of the vulva and vagina.—Rupture of the pelvic articulations.

THE genital canal may be ruptured in any portion of its course. Thus, lacerations may take place through the perinæum and posterior vaginal wall, in the vestibulum, in the fornix of the vagina, in the cervix, in the uterus, and in the pelvic articulations.

Rupture of the Uterus.—Ruptures of the uterus, for the most part at least, start from the lower segment, and thence extend upward toward the body and fundus, or downward toward the vagina. They are termed complete when the rent extends through to the abdominal cavity, and incomplete when confined to either the muscular layers or to the peritonæum.

Bandl reported 19 cases in 40,614 labors (1 : 2,137), occurring in nine years in the Lying-in Hospital at Vienna. Jolly, in Paris, found 230 cases in 782,741 labors (1 : 3,403), but he excluded from his list lacerations of the cervix. Harris, whose authority as a statistician is of the highest, estimates in the United States one case of ruptured uterus to four thousand births. I found 47 deaths from this cause recorded in New York between 1867 and 1875 inclusive, or about one death in six thousand labors. But it is hardly probable that these figures represent anything like the actual mortality; for, whereas in 1875 eleven deaths were returned, there were but four recorded in 1867, and none in the years 1871 and 1872. It is not likely, moreover, that the 47 cases include any other than spontaneous ruptures, as naturally very few physicians are brave enough to record as such ruptures due to violent obstetric manœuvres.

Hugenberger estimated the mortality from ruptured uterus at 95

per cent, C. Braun * at 89 per cent. Their statistics were made up from hospital records. Jolly reported in civil practice 100 saved in 580 cases; but this Harris † believes to be too favorable a showing, as the proportionate loss is much less in published than in unpublished cases. Of late years the treatment of this condition has, however, furnished somewhat better results, and a careful study of the circumstances which favor its production is capable of at least furnishing the groundwork of a rational prophylaxis.

Etiology.—Rupture of the uterus may take place spontaneously as the result of defective resistance offered by the uterine walls to the pressure of the ovum, or it may owe its origin to some external mechanical force.

Rupture of the fundus is a very rare exception. It may take place under special abnormal conditions, as in the one-horned uterus, in imbedded myomata, when cicatrices exist as the result of previous Cæsarean section, and in retrograde changes of the uterine walls.

It is the great merit of Bandl ‡ to have shown that nearly all ruptures begin in the lower segment, and are preceded by an abnormal thinning and distention of that portion of the uterus situated between the ring which bears his name and the os externum. In normal labor it will be remembered that during a pain the fundus and body thicken, while the lower segment is stretched by the ovum. So long as no obstacle exists which hinders the progression of the ovum or the fœtus, this process ends in the conversion of the uterus and vagina into one continuous canal. In such cases the contraction ring is often but slightly indicated, and is found in the neighborhood of the pelvic brim.

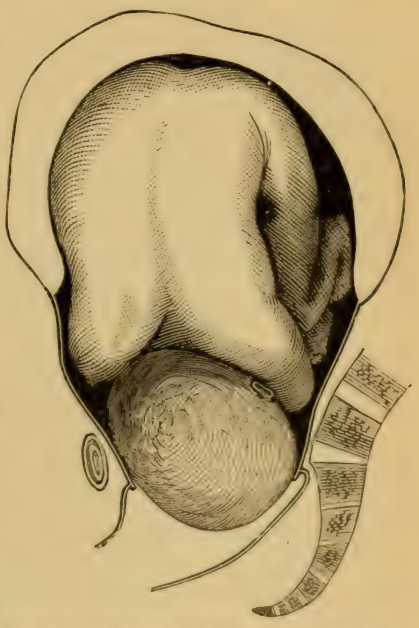


Fig. 228.—Diagram showing dangerous thinning of the lower segment, owing to the non-descent of the head in contracted pelvis. (Bandl.)

If, however, the descent of the fœtus is prevented by any cause, the resistance of the ligaments which hold the uterus in position is over-

* Braun, Lehrbuch der gesammt. Gynaek., p. 699.

† Harris, If a Woman has ruptured her Uterus, what shall be done in order to save her Life? Am. Jour. of Obst., October, 1880.

‡ Bandl, Ueber Ruptur der Gebärmutter, Wien, 1875.

come by the retraction of the fundus and body, and as a consequence the contraction ring is withdrawn upward, the lower segment is thinned, and in extreme cases nearly the entire uterine contents may occupy the distended passive inferior segment. Under these circumstances it is possible at times to detect by palpation the contraction ring a hand's-breadth above the pubes, or even in the neighborhood of the umbilicus. The stretching of the tissues is most pronounced in the upper portion of the lower segment, diminishing below until the vaginal portion is reached, which, of course, is not subjected to tension.

Now, when, as the result of the birth of any considerable portion of the child into the obstetrical cervix—as the stretched lower uterine segment has been termed by Spiegelberg—the tissues of the latter are distended so as to form little more than a membranous covering, the conditions which threaten rupture are established. Thus, contractility is impaired; with each recurring pain, the child, driven still farther from the uterine cavity, increases the pressure upon the already enormously distended lower segment; gradually the thinned tissues separate; the presenting part of the child is forced into the opening; at the height of a pain complete separation of the muscular tissues takes place; the peritonæum is lifted up from the underlying tissue, and finally, in the majority of cases, is torn through, permitting the partial or complete passage of the child into the peritoneal cavity. The emptied uterus then contracts, and the expulsive pains cease. The conditions which specially lead to a dangerous attenuation of the lower uterine segment are the pressure of a hydrocephalic head, a neglected shoulder presentation, and where the descent of the child is hindered by pelvic contraction, by cicatricial tissue or by tumors obstructing the parturient passage. Rupture is favored whenever augmented pressure, as in lateral obliquity and anteflexion of the uterus, and in transverse presentations, is brought to bear upon a limited area of the already overdistended tissues.

There are very great individual differences in the distensibility of the uterine and cervical tissues. In women who have borne many children, rupture may occur before any great degree of stretching has been reached. In the case of which the *post-mortem* appearances are given in Fig. 229, spontaneous rupture occurred in the tenth pregnancy. Labor commenced at noon, and the membranes, which had begun to protrude through the vulva, broke near midnight. The pains then became slow and feeble. At about three o'clock in the morning sudden collapse occurred. On my arrival, thirty minutes later, I found the pulse scarcely perceptible, the breathing hurried, and the extremities cold. As the head was well down in the pelvis, I applied forceps, and extracted without effort a dead child weighing ten and a half pounds. Previous to the collapse the patient had felt comfortable. At the moment of its occurrence a distinct snapping sound was heard by

the hospital physician, Dr. J. D. Griffith, who sat several yards distant from the bedside. The patient stated that she felt a sensation as though a warm fluid was pouring into the abdominal cavity. As the pelvis was ample and the presentation normal, and as there was no irregularity of the labor-pains, the rupture could only be accounted

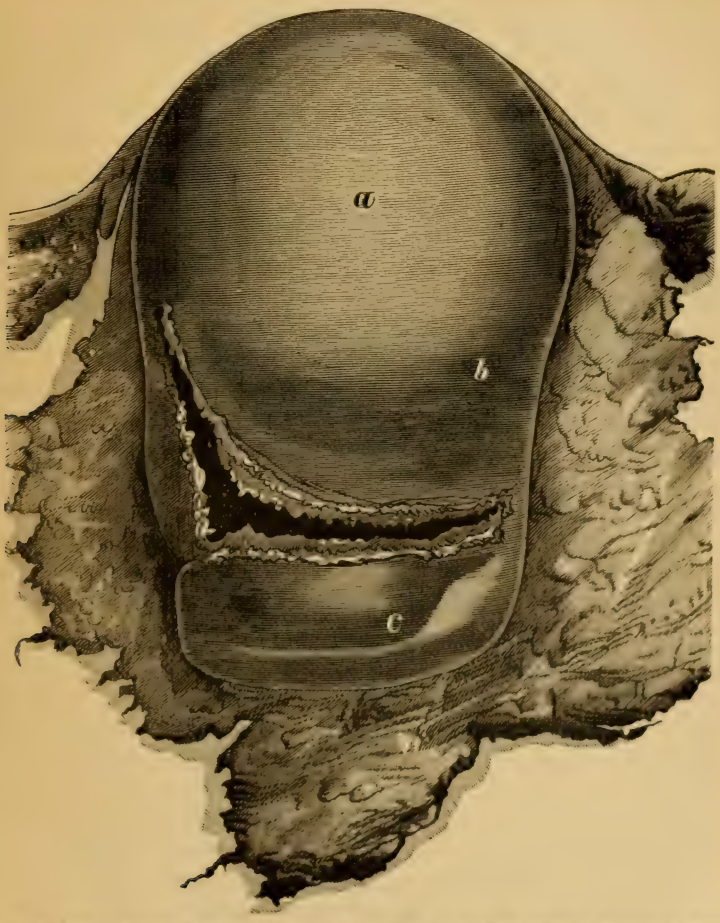


FIG. 229.—Case of ruptured uterus (anterior surface). *a*, body of uterus; *b*, ring of Bandl; *c*, thrombus, shining through the peritonæum.

for by assuming a vulnerability of the uterine tissues, and probably a clamping of the anterior lip between the head and the pelvic wall.

On the other hand, so great is the distensibility of the tissues in certain cases that the fœtus may pass entire from the uterus into the cavity of the obstetrical cervix without laceration ensuing.

Bandl found that of 546 cases of rupture but sixty-four were in primiparæ. Their preponderance in multiparæ is for the most part

the result of the laxity of the round and lateral ligaments of the uterus, which offer accordingly but slight resistance to the recession of the contraction ring; of the stretched condition of the abdominal parietes, which permits obliquities and anteflexion to take place; and of the separation of the recti muscles, which interferes with the use of the abdominal compress.

Of course, the loss of vitality over limited areas, resulting from the compression to which the uterine walls are frequently subjected in deformed pelves, enhances the disposition to rupture. It is likewise obvious that the existence of extreme cervical distention should not be overlooked in cases where operations are rendered necessary. The old prejudice against all operations within the uterine cavity while the cervix is undilated is based in great measure upon the real danger of laceration which proceeds from the association in many cases of the foregoing condition with difficult labor.

Pathological Anatomy.—Rupture may occur in any point of the obstetrical cervix. More commonly it takes place upon the side. Owing to the right lateral obliquity of the uterus, and the greater frequency in shoulder presentations of head-left positions, the left side is oftener affected than the right. The laceration may follow any direction. Longitudinal tears occur usually in shoulder presentations, or where the head is of disproportionate size; the circular rents are for the most part limited to generally contracted pelves. The combination of a transverse with a longitudinal tear, the two meeting at a right angle, is not uncommon. It has been maintained on theoretical grounds that spontaneous rupture is arrested by the contraction ring. This is certainly the rule where there has been no art intervention, but cases reported by myself and others show that exceptionally the rent may extend through the ring to the fundus when there has been no interference. When the uterine walls possess unusual distensibility, a laceration may take place in the peritonæum while the muscular structures remain intact. Again, in some cases, owing to an excessive elasticity of the peritonæum, the latter does not give way even when the child has partially escaped from the uterine cavity. These incomplete ruptures are more likely to occur upon the sides of the uterus, at the site of the folds of the broad ligament, though, owing to the relatively loose attachments of the peritonæum at the lower segment, incomplete ruptures are not necessarily confined to these points. The peritoneal wound is usually more extensive than the uterine, but this rule has its exceptions. When the peritonæum is late in giving way the opening may be of small dimensions.

Some separation of the peritonæum from the underlying structures is usually found in the neighborhood of the rupture. Its extent is dependent upon the degree of tension to which the membrane was subjected before laceration took place. At the body of the uterus the

close connection between the peritonæum and the external muscular layer renders a separation at that point an impossibility.

In the case represented by Fig. 229 the peritonæum was, on the other hand, dissected away anteriorly by effused blood as far as the umbilicus. Hæmatomata are the rule in incomplete ruptures; in complete ones they are also found in cases where the peritonæum has been late in giving way—i. e., after a cavity of considerable size has been formed by its detachment. The borders of the laceration are ragged. The body of the uterus rises high up in the abdominal cavity, and is inclined to the side opposite to that at which the rupture has taken place.

Symptoms and Diagnosis.—The occurrence of rupture may oftentimes be foreseen and guarded against by the early recognition of excessive cervical distention. The development of the latter is possible in any case of obstructed labor. Unless the abdominal walls are very thick, the boundary between the firm, hard body of the uterus and the thinned lower segment, in the form of a transverse or an oblique furrow, may be made out by palpation through the abdominal walls. Upon the sides the round ligaments, even between the pains, have the feel of tense cords. Usually the stretching of the cervix is associated with violent pain, with increased rapidity of pulse, and an anxious expression of countenance.

If rupture occurs, the uterus inclines to the opposite side, the presenting part recedes, and often vomiting sets in. When the rupture takes place gradually, violent manifestations are exceptional. The pains even then may continue, and force the fœtus into the abdominal cavity.

In cases of sudden rupture the pains cease instantly, and symptoms of collapse usually make their appearance.* Vomiting, prostration, the cool skin, the rapid pulse, the drawn features, all point to internal hæmorrhage and shock. Blood flows from the vagina, and the presenting part recedes from the pelvic brim.

Certainty in diagnosis is reached when the uterus upon palpation is found to be empty and the outlines of the child can be made out through the abdominal coverings. If rupture takes place after the presenting part has become fixed in the pelvis, internal exploration is often out of the question previous to the birth of the child. Usually, however, the existence of the rent is easily made out by the examining hand.

* I employ here the term "usually" because in one instance a patient was brought to the Bellevue Hospital in a fairly good condition. On examination I found the child in the uterine cavity, but the head had receded, and, to my surprise, my hand passed through a large rent to the intestines. Winckel (Lehrbuch der Geburtshülfe, p. 563) ascribes sudden symptoms of collapse to the direct introduction of large quantities of poison germs into the abdominal cavity, whereas in cases of traumatism without mycosis the result depends upon the suddenness of the occurrence and the quantity of blood lost.

The passage of the child through the opening into the abdominal cavity is usual; but to this rule there are exceptions. I have seen three cases, two complete and one incomplete, where the child remained within the uterus in spite of the existence of extensive laceration.

The symptoms of incomplete rupture are, at the time of its occurrence, of less severity than the foregoing. The pain and collapse, the cessation of uterine contractions, and the recession of the presenting part are usually absent. Often the rupture may have existed for some time without appreciable phenomena pointing to its existence. The frequent pulse is the most constant sign. As incomplete ruptures have almost always a lateral situation, large vessels are apt to be injured and the internal hæmorrhage to be profuse.

In rare cases subperitoneal emphysema, due to the entrance of air or gases arising from putrefaction, may be recognized by the hand or by the ear on the anterior surface or upon the sides of the uterus, and extending sometimes into the iliac regions.

Treatment—Prophylaxis.—In view of the serious prognosis in cases of uterine rupture, the question of prophylaxis is one of peculiar interest and importance. The outcome of Bandl's demonstration regarding the etiology of the accident is to place in a clear light the responsibility of the physician for its occurrence. If it can not always be foreseen and prevented, there is no excuse for the accident when the development of the recognizable conditions which lead to it is overlooked, or where palpable warnings are neglected.

In multiparæ with contracted pelves, where, as a consequence of previous pregnancies, the ligaments are lax and the lower segment is soft and distensible, it is desirable, so soon as the child is viable, to induce premature labor, and thus to diminish the disproportion between the head and the pelvis.

If the conditions described by Bandl begin to develop during labor, lateral obliquities should be corrected, either by placing the patient upon the side to which the presenting part is turned, or by fixing the uterus with compresses and a bandage in the median line. In hydrocephalus, puncture should be resorted to at an early period.

If the recession of the body of the uterus continues, and the head is movable, version should be performed, provided always that it can be accomplished without violence. In the introduction of the hand, every pains should be taken to correctly appreciate the additional strain to which the cervical tissues are subjected. When an extremity has been seized, and tractions are made, the contraction ring which separates the body from the lower segment interferes alike with the descent of the breech and the ascent of the head into the fundus. If rude force is employed, the increased pressure that temporarily is exerted upon the side of the cervix, which is bulged by the presenting part, can easily give rise to rupture. To avoid any unnecessary strain

during version, counter-pressure should be made over the fundus of the uterus by a trained assistant, while the operator controls the direction of the head by means of his freeh and laid upon the abdominal wall.

If the head is fixed in the pelvis, the forceps is usually available. If, however, the head is movable and version contra-indicated, the forceps is not likely to help the child, and is nearly certain to injure the mother. In a few cases it is possible to press the head into the pelvis by force exerted with the two hands from above the pubes.

If craniotomy becomes necessary, Bandl advises seizing the head in the forceps before using the perforator, as even moderate pressure upward in the tense state of the cervix may lead to laceration.

In neglected shoulder presentations, pains should be taken to ascertain whether the child is living before performing version. This can at times be accomplished by passing the hand upward near the shoulder and feeling for pulsations of the cord. In all extreme cases, the continued retraction of the uterus, by limiting the placental area, is apt to produce fetal asphyxia. If the child is living, the conditions are usually such that version can still be performed, provided care be taken at the same time to press the head from without toward the uterine axis. Excessive distention of the cervix develops much more slowly in primiparæ than in women who have had previous confinements. If the child is dead, or where version is impracticable, decapitation should be employed to release the patient from further danger.

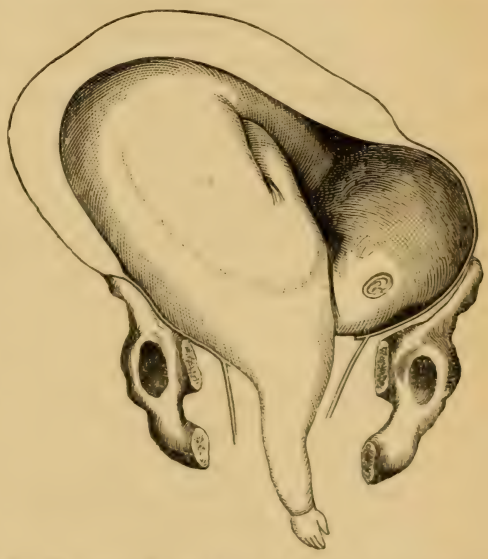


Fig. 230.—Retraction in a case of shoulder presentation. (Bandl.)

Treatment after the Occurrence of Rupture.—If rupture is suspected to have taken place, the child should be delivered without delay. The means of delivery should be selected with the view to enlarge the opening as little as possible. In vertex presentations, if the diagnosis is clear, it is advisable to perforate and extract with the craniocast, as the child is rarely born alive where rupture has taken place.

If the head only has passed through the rent, if the os is dilated, and if the feet are felt near the pelvic brim, the withdrawal of the child

by version is usually effected without difficulty. If, however, the pelvic contraction is extreme, if the cervix is rigid, or if so large a portion of the fœtus has passed into the peritoneal cavity that its withdrawal is liable to increase the size of the laceration, it is doubtless better to incise the abdomen at the linea alba, and deliver through the artificial opening. There is not only less shock, but the opening into the abdomen enables the operator to remove effused blood and amniotic fluid from the peritoneal cavity. Still, the not uncommon impression that the ruptured uterus furnishes a promising field for abdominal surgery does not take into account that in many of the cases where laparotomy is clearly indicated, the patient is practically moribund. The employment of the suture to close the uterine wound, in view of recent Cæsarean successes, sounds reasonable; but it must be remembered that, with ragged borders infiltrated with blood, with the stripping of the peritonæum, and with air or gases sometimes infiltrated into the subperitoneal connective tissue, the conditions for union are in no wise comparable to those which exist when a clean incision is made into a perfectly normal muscular organ. However, in the cases gathered by Harris for the United States, there were $53\frac{11}{16}$ per cent of recoveries.

The supravaginal amputation of the uterus, with suture of the peritonæum below the ligature, promises fairer results, though the deep situation of the tear makes it difficult to secure a healthy pedicle. Godsen collected seven cases, all of which terminated fatally, but more recently Slavjansky, Krassowsky-Halbertsma, Mermann, Fontana, Coe, Wiedow, and Kehrer have each reported a recovery under seemingly desperate conditions.*

If the abdomen is opened, even when hesitation is felt about the deep suture or ablation, there should be none concerning the employment of the peritoneal suture, by means of which the complete rupture is converted into an incomplete one with its more favorable prognosis.

When the child can be removed by the natural passages without an increase of the laceration, and the latter is confined to the lower segment, in all cases where rupture is incomplete, or where the uncertainty as to the extent of the injury leads the physician to shrink from abdominal section, clots in the vicinity of the opening should be removed by the hand, firm contractions should be excited by manual pressure, and every pains should be taken to secure by irrigation an antiseptic condition of the genital tract.

As death, when not due to shock or hæmorrhage, is most frequently the result of septic changes in the retained fluids, *a priori* drainage ought to prove an essential aid to treatment. The correctness of this prevision has been realized by successes obtained through its instru-

* *Vide* paper by H. C. Coe, M. D., Med. Record, Nov. 2, 1889.

mentality by Frommel,* Mosbach, Graefe, Felsenreich,† Hecker,‡ and Mann.* The plan recommended by the latter, based upon the experience of Gustav Braun's clinic, consists in taking a large-sized piece of drainage tubing, and bending it in the middle, so as to leave the extremities of equal length. A large opening should then be made at the arch, which is to be introduced through the point of rupture, and the descending branches of the tube should be fastened together to prevent the formation of a bridge of tissue between them during the process of healing. The upper end of the drainage apparatus should be passed from a half-inch to an inch beyond the torn borders of the uterine wound, and the lower ends stitched with silk to the posterior commissure. Over the vulva and the apparatus there should be placed an antiseptic dressing, which should be changed several times daily. After the first four or five days, by which time it may be assumed that protective adhesions will have formed in the neighborhood, a regular irrigation of the wound with a two-per-cent solution of carbolic acid should be carried out, with a view to prevent a septic poisoning from the decomposition of the pus and the lochia.

More recently, in the discussion before the Geburtshülflich Gynaekologischen Gesellschaft,‖ of Vienna, it was recommended to secure drainage, either as above, by rubber tubing, or by means of lamp wicking (fifty threads) prepared with iodoform, while the vagina was loosely packed with iodoform gauze. Drainage should be supported by every means calculated to maintain uterine contractions and check hæmorrhage. These objects are best secured by manual compression of the uterus, either with or without conjoined pressure of the aorta, to be continued if necessary for hours. Before leaving the patient a graduated compress should be placed around the uterus, to maintain firm uterine contractions, or, what I regard as preferable in these and analogous cases, a rubber water-bag, which adjusts itself to the contour of the uterus and is hardly less effective than the hand itself.

In the Vienna discussion alluded to Dr. Fleischman stated that in eighteen cases of anterior rupture, five of which had been treated by drainage, all died; whereas, of fourteen cases of posterior rupture, of five treated by drainage all recovered.

In certain of the reported cases of recovery where drainage was em-

* Frommel, Zur Aetiologie und Therapie der Uterusruptur, Ztschr. f. Geburtsh. und Gynaek., Bd. v. Heft 2.

† Felsenreich, Beitrag zur Therapie der Uterusruptur, Arch. f. Gynaek., Bd. xvii, Heft 3.

‡ Hecker, Centralblatt f. Gynaek., 1881, No. x.

* Mann, Centralblatt f. Gynaek., 1881, No. xvi. Drainage in the cases referred to was employed in complete as well as in incomplete ruptures. The triumph of the principle of drainage is best demonstrated by the fact that in most of the cases gastrotomy was contra-indicated by reason of excessive shock.

‖ Sitzung's Berichte, 1888, No. 9.

ployed an opening was let in the uterine wall communicating with an adjacent sac formed either by the folds of the broad ligament or by false membranes which persisted after the removal of the dressings.

Rupture limited to the Peritoneal Covering of the Uterus.—This very rare form requires but brief mention. In all but ten cases have been reported. It occurs under apparently normal conditions, without premonitory symptoms. It is supposed to be due to deficient elasticity of the peritonæum, and may take place during either pregnancy or labor. Death in the known cases resulted from internal hæmorrhage, from peritonitis, or from shock (Spiegelberg).

Perforation from Pressure.—In studying the influence of the contracted pelvis, we have already had occasion to consider the origin of circumscribed losses of substance in the uterus due to the pressure of the pelvic walls. In the present connection it is only necessary to state that they are more frequently followed by recovery than the ruptures, in favorable cases exudation closing the opening and the necrosed tissue passing away through the vagina.

Lacerations of the Vaginal Portion of the Cervix.—Lacerations at the os externum of moderate extent are the nearly constant concomitant of physiological labor. The "show" of monthly nurses consists of mucus tinged with blood furnished from the slight tears which are produced during the passage of the head through the cervical orifice. At times, however, these lacerations may assume a pathological importance, reaching upward to the vaginal junction, or even, in extreme cases, stretching outward through the upper portion of the vagina. At the time of their occurrence, they give rise to no special symptoms. After the birth of the child, they may become the source of *post-partum* hæmorrhage, or they may interfere with involution, and during childbed expose the patient to the risks of infection. In after-life they furnish the foundation of a multitude of uterine disorders (Emmet). They occur most frequently in primiparæ, especially elderly ones; in œdema of the cervix; in cases where the anterior lip, pushed downward by the occiput, is caught between the head and the pubic walls, and thus is prevented from retracting simultaneously with the posterior lip; and as a consequence of obstetrical operations. Severe lacerations extending above the vaginal junction are most frequently produced in pelvic deliveries, where the head is extracted by force through an imperfectly dilated os.

Most commonly these lacerations follow a longitudinal direction. In rare cases, where there is extreme rigidity of the os externum, or where, after the escape of the amniotic fluid, the head distends the anterior lip without pressing upon the os, a transverse rent may occur through which the child may pass. Sometimes a longitudinal tear may be combined with one running transversely, the lip then hanging by a pedicle to the uterus, or the entire lip may be torn off. Isolated cases

of so-called annular laceration have been reported, where the transverse rent has extended through the whole vaginal portion, so that the lower segment has been detached in the form of a ring. In these cases hæmorrhages very rarely if ever occur.

In addition to the ordinary principles which should govern the management of every labor, Bandl lays great stress upon the pushing up of the confined anterior lip as an important prophylactic measure.

Hæmorrhage due to cervical laceration should be controlled by closing the rent with silver or catgut sutures. In view of the bad light by which the operation has usually to be performed, the suggestion of Schroeder, to draw the cervix with the volsella forceps outside the vulva, while an assistant pushes the uterus down into the pelvis from above, is worthy of being borne in mind. With the wounded parts thus exposed, the reparative operation advocated presents scarcely appreciable difficulties to even the least surgical of attendants.

If no hæmorrhage occurs, cervical lacerations are rarely recognized except by physicians who take pains to invariably investigate the *post-partum* condition of every patient. As a rule, with strict antisepsis they heal rapidly during involution. Nevertheless, it is my present custom to close all extensive lacerations with a continuous catgut suture. After the expulsion of the placenta the operation is easy, is devoid of risk, and is followed by speedy union of the torn surfaces. For the gynæcological expert Veit recommends the passage of the sutures without the aid of the speculum, by the touch alone. This he accomplishes by means of a needle seized at right angles with a long-handled needle holder. The needle he passes first through the anterior, and then through the posterior lip, under the guidance of two fingers of the left hand, while the fundus is depressed by an assistant from above. Traction upon the first suture materially aids in the introduction of the others.

Lacerations of the Vagina.—Vaginal lacerations vary in gravity according to their extent and position. In the upper part of the canal they are, as a rule, continuous with ruptures begun in the uterus or in the vaginal portion. In contracted pelves, where, owing to excessive retraction, the head fills the vagina without entering the pelvic brim, isolated lacerations of the vagina may follow the same general causes as those which give rise to rupture of the uterus. Perhaps the most common vaginal lesion is that produced by the unguarded blades of the forceps when applied diagonally in place of directly to the sides of the child's head.

In the lower portion of the canal these lacerations heal speedily without serious symptoms, provided cleanliness be maintained from the first. Lacerations of the fornix only are of great importance on account of their proximity to the peritonæum, and because of the exposure of the parametrium to septic absorption. The immediate closure, there-

fore, of these rents with silver sutures ought to be attempted. Owing to the laxity of the tissues, the difficulties of reaching the wound are not excessive, while the dangers to be forestalled are of a peculiarly threatening character.

The origin and nature of fistulous communications with the bladder and the rectum have already been considered in connection with the pathology of labor. Resulting for the most part from necrosis due to pressure, they are rarely the immediate sequelæ of childbirth, the sloughing of the dead tissue taking place during the course of the puerperal period. The treatment in such cases belongs properly to the domain of gynæcology. The closure by suture is only available as a plan of treatment in cases where complete laceration through the tissues into the neighboring organs takes place during labor, as the consequence of rudely performed obstetrical operations.

Lacerations of the Vaginal Orifice.—Owing to the small size of the vaginal orifice, tears through the mucous membrane and erosions of the vulva, and, in primiparæ, the rupture of the frenulum, are to be accounted as the almost inevitable consequences of childbirth. They are the principal cause of the external soreness experienced after labor. In healthy localities they heal rapidly, and are of but trivial importance. Of greater moment are deep perineal lacerations and those of the vestibulum.

Lacerations of the Vestibulum.—Tears limited to the mucous membrane are usually found after labor at the sides of the clitoris. In exceptional cases these tears may involve the underlying erectile tissue (bulbs of the vestibule), and become the source of profuse or, when overlooked, even of fatal hæmorrhage. The blood, which may be either venous, arterial, or of mixed origin, spurts in jets or oozes as from a soaked sponge. The recognition of the lesion is easy upon inspection. It should always be thought of as a possible cause of *post-partum* hæmorrhage in every case where the flow continues after the contraction of the uterus.

The bleeding may be temporarily arrested by pressing the tissues with the finger against the inner surface of the pubic bones until the expulsion of the placenta. Ligatures to the bleeding vessels, owing to the complexity of the structures, are of no avail. In slight cases a stream of cold water is a sufficient hæmostatic. In others, the bleeding requires to be checked by one or two deep sutures introduced so as to bring the torn surfaces into apposition. If the bleeding appears to come from one or two points, the *pinces hémostatiques* are of service. Styptics and astringents are usually effective, but they possess the drawback of augmenting the pain and soreness.

Lacerations of the Perinæum.—In the chapter upon the Management of Normal Labor, the nature, origin, and prevention of perineal lacerations have already been considered. The diagnosis is made by a

careful inspection of the genital organs after delivery. The extent of the lesion is estimated by including the recto-vaginal septum between the thumb and index-finger.

The treatment of perineal laceration consists either in keeping the woman in bed until the wounded surfaces cicatrize, or in bringing the parts into apposition by means of sutures, with the intent to secure primary union. The first plan is sufficient if the wound be of slight extent. If, however, the rupture extends to the sphincter ani, and involves the entire perineal body, the vagina is left without support, rectocele or cystocele ensues, the uterus sinks downward and becomes displaced backward, and in the end prolapsus is apt to result. If the sphincter ani and the recto-vaginal wall are involved, inability to restrain the bowels adds to the discomfort of the patient. This sequence of symptoms, so familiar to gynæcologists, forms an urgent plea for the resort to surgical means to repair the injury. Only a very credulous person really believes that he has witnessed union by first intention in extensive ruptures, as the result of tying the knees together and enjoining rest upon the side. The action of the transversi-perinæi muscles tends to draw the torn surface apart. Moreover, the necessity of separating the knees in passing urine, and to enable the nurse to cleanse the genitalia, makes it impossible to keep them in contact for any lengthened period.

To the immediate operation there is no valid objection. It is not difficult, it is not extremely painful, and its performance, as a rule, diminishes the risks of infection and shortens the puerperal period. It is true that the object aimed at may not be attained. If labor has been conducted in accordance with antiseptic principles, if no syphilis exists, and the vitality of the tissues has not been impaired by œdema or long-continued pressure, failure is the exception. The argument that the operation is in itself a confession does not deserve discussion.

For its performance the patient should lie upon her back, with her hips well over the edge of the bed. Two assistants to hold the knees are of great convenience. In operations requiring the introduction of not more than three or four sutures anæsthesia may be dispensed with. In lengthy operations, such as are necessitated by lacerations extending up the posterior vaginal wall, ether should be given in place of chloroform, and its administration should be intrusted to an experienced person only. It can not be too often repeated that anæsthesia after labor calls for the exercise of extreme caution.

The wound should be prepared by carefully washing away blood and clots with warm carbolized water. For lacerations not extending through the sphincter ani I use Peaslee's needle, which is furnished with an eye at the point, and is set in a wooden handle. It possesses the advantage of strength, a quality of no mean importance in making the circuit of the redundant tissues with which we have to deal after

labor. I use the silver suture, and after repeated trials have not been able to convince myself that it can be equally well replaced by silk.

The first suture should be passed just in front of the anus. It should be entered and brought out about a half-inch from the ruptured borders. The others should follow at from one third to one half inch intervals. Each suture should make the entire circuit of the wound. This can be readily accomplished by guiding the point of the needle through the residue of the perineal body with two fingers in the anus and with the thumb upon the vaginal surface. To secure a stronger hold for the last suture, the needle should be made to enter the vagina above the upper angle of the rent, and the wire should be made to traverse a portion of undenuded tissue before completing the circuit. In closing the wound, great pains must be taken not to twist the sutures too tightly, as in that case they are apt either to cut out or to produce sloughing.

Sometimes, in rents extending through the sphincter ani and the recto-vaginal septum, the simple perineal sutures will effect a satisfactory union. Thus, in a patient at the Emergency Hospital, with a laceration extending nearly to the cervix, and whose condition precluded a lengthy operation, I obtained an excellent result by passing a single wire above the angle of the wound, and twisting the ends outside the perinæum. As a rule, however, it is desirable to adjust the edges with great care, first closing the rent upon the rectal side, then bringing together the split in the mucous membrane upon the vaginal side with transverse sutures, and finally bringing the lower borders of the perinæum together by a separate operation. This disposition is the so-called triangular suture of Simon.* It requires fine needles, a needle-holder, an adjuster, a wire-twister, and, in fact, all the paraphernalia of the gynæcologist. The length of the operation renders necessary an anæsthetic, which should be ether rather than chloroform. The disgusting condition of a patient with laceration through the recto-vaginal septum, where the healing process has been the result of granulation, justifies the attempt to secure immediate union.

The requirements in the way of after-treatment are very simple. The urine should be drawn every four to six hours with a catheter, until the patient is able to pass her water spontaneously; the bowels should be kept open with salines; and the knees should be tied loosely, to remind the woman of the desirability of keeping them in contact. The wound should be kept scrupulously clean. Whenever urine has been passed the perinæum should be washed with warm carbolized water, then dried, and sprinkled with iodoform. Pads of iodoform gauze should be placed to the sides of the sutures to prevent them from causing ulceration of the adjacent soft parts. A little opium

* *Vide* GARRIGUES's excellent paper entitled The Obstetric Treatment of the Perinæum, Am. Jour. of Obstet., April, 1880.

may be given, if the pain experienced is considerable. Pain in childbed from any cause helps to depress the vitality. The perineal sutures should be left a week *in situ*. Many promising cases are spoiled by removing the sutures too early. The vaginal sutures may be allowed to remain until the external union is sufficiently solid to permit the introduction of the speculum. Catgut sutures for the rectum are to be preferred when they can be obtained of good quality, as they obviate the necessity of future removal.

For the more superficial lacerations of the perinæum the *serres fines* invented by Vidal de Cassis, and extensively used in Vienna, have been warmly advocated in this country by Professor M. D. Mann,* and by Garrigues.† My own experience with them has not been fortunate; but the better results from their use in the hands of their supporters recommend them to trial.

Thrombus of the Vagina and Vulva.—Hæmorrhagic effusions into the external organs of generation occur with greatest frequency in the labia majora, more rarely in the labia minora, and occasionally between the superficial and median fasciæ of the perinæum. These extravasations may form tumors beneath the subcutaneous or submucous tissues of the vulva or vagina, which vary in size from that of a hen's egg to that of a child's head. As a rule, the blood is poured out into the cellular tissue seated below the diaphragm of the pelvis. The extravasation may, however, stretch upward along the vagina to the cellular tissue of the uterus, then posteriorly beneath the peritonæum to the kidneys, and around in front to the navel and laterally to the iliac fossæ (Winckel). The source of the hæmorrhage may be venous or arterial. The vessel from which the hæmorrhage takes place is usually situated in the lower portion of the vagina; in less frequent cases, in the vulva.

Symptoms.—The first sensation experienced at the time of the rupture is usually one of intense pain, proportioned to the size of the tumor and the rapidity of its formation, though in a case witnessed by Professor Barker‡ this symptom was absent. As the effusion continues, swelling of the vulva, usually upon one side, results, and the skin becomes blue and nearly translucent. The patient complains of pain, and feels faint, while her lips and cheeks grow white. If the sac contains fluid blood, fluctuation is detected; after coagulation the tumor has a soft, boggy feel. If the tension increases, the skin may yield, the blood and coagula escape, and, if no means be adopted to arrest the hæmorrhage, the patient may die in a few minutes from acute anæmia.

If the thrombus be of small size and situated low down, the after-

* Mann, The Immediate Treatment of Superficial Rupture of the Perinæum, Am. Jour. of Obstet., November, 1874.

† Garrigues, *loc. cit.*

‡ Barker, Puerperal Diseases, p. 58.

symptoms may be of slight importance. The fluid may be absorbed, the walls of the cavity unite, and the tumor disappear entirely. Tumors of larger size produce symptoms referable to pressure, such as back-ache, rectal obstruction, and ischuria. The vagina may be so narrowed as scarcely to permit the passage of the finger. Rupture, if not immediate, usually occurs spontaneously in the course of a few days, and is, as a rule, preceded by necrosis of a portion of the detached mucous membrane. The most frequent point of spontaneous rupture is at the junction of the larger and smaller labium. If the necrosed tissues become gangrenous, death from septicæmia may result. Winckel * sums up the various terminations of thrombus as follows: 1. Death from hæmorrhage, with or without precedent rupture; 2. Death from decomposition of the sac contents, with consecutive septicæmia or septico-pyæmia, most frequently after rupture or opening of the sac; 3. Rupture and recovery; 4. Rupture, with formation of fistulæ; 5. Absorption without rupture, followed by recovery.

Diagnosis.—The diagnosis is simple. The rapid development and increase of the tumor, its bluish color, its elastic or fluctuating character, the sharp pain, and the acute anæmia, occurring independently of uterine hæmorrhage, sufficiently point to a sanguineous effusion into the subcutaneous cellular tissue. The extent of the tumor must be determined by rectal and vaginal exploration. It is only at the beginning that it will be found possible to ascertain the seat of the hæmorrhage, whether in the vulva, vagina, or perinæum. Sometimes, after rupture and the discharge of the clots, the bleeding vessel may be detected.

Etiology.—The formation of the thrombous tumor, with rare exceptions, takes place during or shortly after labor. If the vessel rupture in advance of the presenting part, the effusion may be immediate and furnish an obstacle to delivery, or the descent of the fœtus may check the hæmorrhage for a time, to break out afresh after the labor is ended. In rupture due to necrosis consequent upon pressure, the hæmorrhage does not, of course, take place until sloughing occurs. Rupture may follow excessive straining, rapid dilatation of the genital canal, or direct injuries. A varicose condition of the veins does indeed create a predisposition to rupture, but is by no means a frequent factor in the production of the accident. Thus, it was present in but six of the fifty cases collected by Winckel.

Prognosis.—The prognosis of vaginal thrombus is serious. Deneux reported twenty-two deaths in sixty cases, a mortality evidently excessive; Winckel reported six deaths in fifty cases; Barker reported two deaths in twenty-two cases; and Scanzoni one death in fifteen cases. But statistics like these are apt to give rise to a misleading impression. A thrombus *per se* is rarely a dangerous complication. It

* Winckel, Die Pathologie und Therapie des Wochenbetts, 2te Auflage, p. 132.

may, however, become so either because after rupture no means are adopted to limit the amount of hæmorrhage, or because, in unhealthy localities, the tense membrane covering the tumor is liable to become gangrenous, and the vast vaginal wound furnishes at once a congenial soil for the multiplication of septic germs, and an absorbent surface by which the septic poison generated is afforded a ready entry into the adjacent cellular tissue. Thus, Barker reports nine cases in private practice, in all of which the patients recovered. Of thirteen cases in hospital practice, two patients died of puerperal fever. The prognosis is likewise less favorable in cases where there exists at the same time extensive separation of the peritonæum.

Treatment.—The conditions of successful treatment are restriction of the hæmorrhage and the prevention of septicæmia. Early recognition of the accident is very desirable.

So soon as effusion is recognized the forceps should be applied, and the head should be extracted as speedily as is consistent with the preservation of the integrity of the maternal tissues. To quote from Professor Barker's excellent treatise: "The exciting cause of the accident is the arrest of the circulation by the mechanical pressure of the presenting part of the fœtus. The sooner the pressure is removed, the sooner the danger will be over and the less will be the injury to the parts." Moreover, as we have seen, the head in its descent acts as a tampon, by means of which the hæmorrhage, whether external or in the submucous tissue, is temporarily held in check. If the tumor in advance of the head is so large that the delivery can not be accomplished without impairing the vitality of the sac-walls, the danger should be averted by incising the thrombus and turning out the coagula.

Hæmorrhage after the birth of the child is apt to be very profuse, especially if the sac has been opened either by spontaneous rupture of its coverings or with the knife. So long as the sac-walls are intact, the pent-up blood exercises a considerable pressure upon the bleeding vessel. For this reason it is well to cover an opening, if one happens to have formed, with lint soaked in a solution of one of the per-salts of iron. The continuance of internal hæmorrhage should then be checked by means of a water-bag (a large Barnes dilator will suffice) introduced into the vagina and distended with ice-water. The hydrostatic pressure rarely requires to be maintained for longer than half a day, during which time it should be repeatedly removed for a few moments to allow the vagina to be cleansed by disinfectant injections. The urine should be drawn with a catheter during the first forty-eight hours, as every straining effort is to be carefully guarded against. A tampon of linen rags, or of cotton, is inadmissible on account of the tendency it possesses to excite rapid decomposition in the lochial discharges. Immediate opening of the thrombus, followed by emptying

the sac and filling the cavity with lint soaked in astringent solutions, are measures which should, on account of the suppuration likely to be thereby excited, be reserved for cases where milder procedures have proved ineffective.

The ultimate opening of the sac, after the hæmorrhage has once been arrested, is rarely to be avoided. Still, cases are on record where tumors the size of a man's fist have disappeared by absorption. As this is the most favorable mode of termination, every effort should be made to secure such a result. To this end quiet should be enjoined, cold should be employed, and pain should be subdued by opiates. If, however, the tumor increases in size, the skin becomes greatly discolored, and vesicles form upon its surface, it is better to anticipate threatened gangrene or rupture by incision. If the circumstances permit of delay, it is better to wait three to four days to make sure of the stoppage of bleeding. The best point for laying open the tumor is upon the inner surface of the labium majus. The incision should be two to three inches in length. After turning out the clots the cavity should be irrigated with a bichloride solution (1 to 2,000) and should then be packed with iodoform gauze.

Rupture of the Pelvic Articulations.*—Rupture of the pelvic articulations may take place spontaneously where either inflammation or excessive relaxation of the joints exists at the time of labor. More commonly it is the result of difficult forceps operations performed in cases of contracted pelves. The risk of the occurrence of this accident is especially great when the forceps is applied to the head at the brim and forcible tractions are made in a direction anterior to the pelvic axis.

The symphysis is the articulation which is principally exposed to this form of injury, though it is obvious that no increase in the capacity of the pelvis consequent upon the separation of the symphysis is possible without simultaneous rupture of at least one of the sacro-iliac synchondroses. At the symphysis the rupture is apt to be complete, at the synchondroses the rupture is usually confined to the anterior surface. It may take place in the median line, or upon the side, between the cartilage and the pubic bone. If the injury be slight, the synovial cavity of the symphysis may not be injured. At the synchondroses, opening of the joint-cavity is inevitable. An excessive degree of the lesion is accompanied by laceration of the vagina, the bladder, and the intervening connective tissue.

Occasionally the rupture of the joint is announced by a perceptible sound, by intense pain, and, as the result of the increase in the pelvic space, by rapid advance of the head. In the lighter forms, however, which make up the bulk of the cases witnessed, there are no distinct-

* Ahlfeld, Die Verletzungen der Beckengelenke während d. Geburt und im Wochenbett, Schmidt's Jahrbücher, Bd. 169, 1876, p. 185; Spiegelberg, Lehrbuch, p. 636.

ive symptoms at the time of the accident. The pathognomonic secondary manifestations are outward rotation of the thighs and localized pain, increased by movement of the limbs and relieved by fixation of the pelvis. Objective evidence of rupture at the symphysis is afforded by the movements produced at the articulation by alternate pressure upon the ends of the pubic bones and by combined internal and external examination. If the rent extends to the vagina, the laceration may be detected by the touch. Separation of the sacro-iliac synchondroses is rendered probable if violent pain is excited by alternately pressing the anterior portions of the ilia together and then drawing them apart from one another. Bladder disturbances are rare except in cases where the separation at the symphysis is complete, or where the rupture is followed by inflammation and the formation of pus.

The treatment consists in supporting the pelvis by means of a suitable bandage, in keeping the patient upon her back, and in maintaining strict cleanliness. The bowels should for a time be kept confined. As regards the first indication, Spiegelberg says an ordinary towel properly folded and fastened at the pubes, with care taken to avoid pressure upon the crests of the ilia, will answer all the requirements. Rupture of the pelvic articulations, when not complicated by other lesions, or by puerperal infection, run for the most part a favorable course. During convalescence the patient should wear some form of permanent bandage, such as has been recommended in cases of relaxation of the pelvic symphyses.

CHAPTER XXXIV.

PROLAPSE OF THE FUNIS, ETC.

Prolapsed funis.—Asphyxia neonatorum.—Collapse and sudden death during labor and childbed from thrombosis, from embolism, and from entrance of air into the circulation.—On the extraction of the child in case of death of the mother in pregnancy or labor.—Tympanites uteri.

When the cord is felt within the membranes next to the presenting part, a funis presentation is said to exist. After the membranes have ruptured, the cord descends into the vagina, in front of the presenting part, and is then said to be prolapsed. Generally the cord occupies one of the hollows upon the sides of the promontory; less frequently it descends opposite the lateral walls of the pelvis; the site in front of the promontory or behind the pubes is very exceptional.

As regards the frequency of the accident, the experience of individuals varies widely. Churchill collected 98,512 cases of labor in which

it occurred 401 times, or in the proportion of one to 245·5 cases. Dr. Christisen, of Wyandotte, Michigan, met with it 23 times in 1,516 cases. Meachem met with it 10 times in 931 cases. Mr. Bland met with it, on the other hand, but once in 1,897 cases.*

Prolapse of the cord occurs only in cases where the presenting part does not completely occlude the lower uterine segment. It is favored by a long cord, by a deep placental site, by the insertio velamentosa, by oblique and breech presentations, by prolapse of the extremities, by hydramnios, by multiple pregnancies, and, above all, by the contracted pelvis. On account of the more frequent concurrence of these conditions in multiparæ, the accident is oftener found in them than in primparæ.

Duncan† has called attention to what he terms "expression of the cord," i. e., where the cord is squeezed out of the uterus long after the escape of the liquor amnii. Of this phenomenon he says that, during labor and after the discharge of the waters: "All parts of the fœtus are propelled, but not at the same rate . . .; and the rate of progress of parts will vary according to the resistance. More mobile parts will have, in consequence of that mobility, less resistance to encounter, and it is plain that the limbs and the cord are the most mobile of the solid parts."

The diagnosis of prolapsed funis is easy. If necessary, the loop can be drawn outside of the vagina. Previous to rupture it forms a smooth, round, compressible, mobile body, not to be confounded with any other floating object liable to be encountered within the ovum. When the pulsations of the umbilical vessels are distinctly felt, the child is demonstrated to be alive. In the second stage, however, the pulsations may cease for a moment during a pain, to return again in the ensuing interval. As the heart sometimes continues to beat for a few minutes after the circulation in the cord has ended, it is proper to carefully auscultate before assuming death to have taken place (Spiegelberg).

The prognosis, so far as regards the children, is extremely unfavorable, more than one half dying during labor. This fatality is owing to the pressure to which the cord is subjected during the passage of the child through the pelvis. There are, however, a variety of circumstances which substantially modify the extent of the danger. Thus, in transverse presentations the cord is scarcely or not at all exposed to pressure. In breech presentations the prognosis is good, owing to the soft consistence and small size of the pelvic extremity, and to the fact that, where the life of the child is in peril, the conditions are such as to permit of speedy extraction.

* These statistics I have borrowed from an article on the Presentation of the Funis, by Dr. J. G. Meachem, reprinted from The Transactions of the State Medical Society of Wisconsin 1880.

† Duncan, On Expression of the Cord, Obstet. Trans., vol. xxi, p. 302.

The most serious cases are those where prolapse occurs as a complication of head presentations. Engelmann found that the infant mortality in the latter was sixty-four per cent, while in footling presentations it was but thirty-two per cent. Favorable conditions in head presentations are a large, roomy pelvis and preservation of the membranes until cervical dilatation is completed. Of unfavorable import are a deep placental site, a contracted pelvis, and early rupture of the membranes.

Treatment.—From the foregoing it will be seen that the one indication for treatment in this anomaly is to relieve the cord from pressure. The conduct of the physician in each individual case will depend upon the presentation and the modifying circumstances.

If the head presents, so long as the membranes remain intact, and the dilatation of the cervix is incomplete, an expectant attitude should be maintained. Premature rupture should be guarded against by placing the patient in the latero-prone position, by forbidding her to strain, and by supporting the membranes by means of a moderately distended Barnes dilator introduced into the vagina. It is not rare in this class of cases, as the head descends, for the cord to be withdrawn upward into a place of safety. The more complete the dilatation before rupture, the more rapid the subsequent delivery of the child, and the greater the chance, therefore, of preserving its life. If, however, upon auscultation, there are signs of failing heart-action, an attempt should be made to push the cord upward with the fingers through the membranes. In case of success, in order to prevent a relapse, the sac should be ruptured, and the head should be brought down so as to fill the cervical canal.

After rupture of the membranes, if the cervix is well dilated, the pains are good, and the head enters quickly into the pelvic cavity, the case may be left to Nature. Spiegelberg mentions five cases, in his own practice, where the birth of the child took place so rapidly that no harm resulted from the descent of the cord. If the pains are feeble, and speedy progress is not made, the forceps should be applied.

If, after dilatation of the cervix, the head remains high and movable above the brim, the forceps should not be employed. It is then dangerous to the mother, and offers but scant hope of proving of service to the child. The choice in such cases falls either upon reposition of the cord or version.

Reposition of the prolapsed cord, as the milder procedure, should be first attempted. The reposition is most easily accomplished in the knee-chest position, as has been beautifully demonstrated by Gaillard Thomas.* By the simple plan of reversing the direction of the uterine axis, all the conditions which had previously favored the descent of the

* Thomas, Postural Treatment of Prolapsed Funis, Trans. of the New York Acad. of Med., 1858.

cord are made to promote its return into the uterine cavity. Thus the intra-abdominal pressure is removed, the amniotic fluid is retained, the head is easily pushed to one side so as to permit the introduction of the hand, and the cord tends to glide by its own weight over the declivity furnished by the anterior wall to the fundus. The loop should be seized in the hollow of the hand, and should be carefully sheltered from pressure. It should be shoved beyond the greatest circumference of the head, and, where possible, to the back of the child's neck. As in all cases where the hand has to be passed through the cervix, the uterus should be sustained by pressure from without. With the advent of a pain, all manipulation should cease, to be renewed, however, as relaxation follows. If the replacement proves successful, the hand should be withdrawn gradually, while the head becomes fixed in the lower segment. This latter result may frequently be expedited by judiciously directed external pressure. As a precaution against relapse, the patient should be placed in the latero-prone position, with the hips elevated by a pillow.

The Postural Treatment of Prolapse of the Funis.—K. F. J. Birnbaum* finds that quite frequent mention has been made by authors of the advantages to be derived from posture in the treatment of cases of prolapsed funis. The works of Camper, published about the middle of the seventeenth century, and referred to by Kiestra, he had no means of obtaining access to. Deventer† considers the subject of prolapsed funis *in extenso*, takes up its different modifications, its effect upon parturition and the life of the child, and the treatment it demands. In cases where the cord was pressed against either ilium, he directed to place the woman upon the corresponding side, with raised pelvis, and with the hand (right hand if on the left side, and *vice versa*) to lift the head, replace the cord, then, as seemed advisable, either to bring the head into the pelvis, or to turn and extract by the feet. When the cord was pressed against the pubes or the sacrum, he advised that the midwife should place the woman upon her knees with her body thrown forward, and that, in this position, the accoucheur should raise the head and return the cord; if the woman should be too weak for this, she should be placed upon the side with one limb drawn up under the body. John Mowbray‡ advises that the woman, if strong enough, should be placed upon her knees and elbows in cases where the cord lies next the sacrum or the pubes. Henry Bracken, a pupil of Boerhaave,# proposed returning the funis in head presentations, with the woman placed upon the knees, and afterward to bring the fetal head into the pelvis. Ludwig Wilhelm von Knoer‖ devoted a long chapter to funis presentations. He says: "Introduce the hand so soon as the membranes rupture, and, according to the position of the child, perform either podalic or cephalic version, placing the woman at the same time upon

* Monatsschr. f. Geburtsk., October, 1867.

† Operationes chirurgicæ novum lumen exhibentes obstetricantibus, Lugd. Bat., 1701.

‡ The Female Physician, containing all the Diseases incident to that Sex, London, 1724.

Midwife's Companion; or a Treatise of Midwifery, London, 1737.

‖ Frauen-Zimmer Medicus, Leipsic, 1747.

her knees to prevent the protrusion of the cord." George Daniel Boessel* recommends turning in cases of funis presentation, and, in cases of difficulty, to perform version with the woman placed upon the knees. In recent times, Van Ritgen has certainly been the most ardent partisan of postural methods of treatment. In his work entitled Anzeigen der mechanischen Hülfen bei Entbindungen, published in 1820, he recommends them in a great variety of circumstances, but not then for prolapsed funis; but in his Lehr- und Handbuch der Geburtshülfe für Hebammen (Mainz, 1838) he says: "When the funis presents, the midwife should instantly send for the accoucheur; meanwhile she should herself place the woman, if strong enough, upon her knees and elbows, and attempt the replacement of the cord; if the woman is too weak to admit of this, she should be placed upon her side, with elevated pelvis. That side should be chosen upon which the funis is not situated. If the manipulation is successful, the posture should be maintained to prevent a recurrence of the prolapse." He recommends the position upon the elbows and knees for cases of prolapsed funis and transverse presentations in breech or foot presentations, also where the head is movable above the brim, and where there is no attainable presenting part. He advises returning the funis high up with the hand, and then to let it fall into the uterus, where it would no longer be subjected to pressure. After reposition, place the woman upon her side, with raised pelvis. Sometimes the postural method suffices without any manipulations. Kiestra† advises the position upon the knees and elbows in cases where the cord is felt near the head previous to rupture of the membranes, to prevent the occurrence of prolapse. After the rupture of the membranes, he says, the same position should be employed to facilitate the return of the cord, and should be maintained until the head is fairly engaged in the pelvis. Where the position could not be endured long enough, he counseled placing the woman in a half-kneeling, half-recumbent posture, with the sides supported by cushions. Theobold, in 1860, hit upon the same idea. He considered the most favorable condition for the return of the funis was to place the woman upon her head, but, in view of the difficulty attending the execution of this manœuvre, compromised the matter by suggesting the position upon the elbows and knees.

The advantages of the postural method in the treatment of prolapsed cord are beyond all question. It is, however, difficult to persuade the woman to long maintain so constrained an attitude, and the cases are not rare where, in spite of gravity, the cord is expressed from the uterine cavity. Efforts at replacement should not, therefore, be long continued. It is impossible to handle the cord for any lengthy period without enfeebling the force of the fetal heart. So soon, therefore, as it becomes evident that nothing is to be gained by further persistence, the hand should be pushed up to the feet, and the safety of the child should be secured by speedy extraction. In cases of contracted pelvis the question of version must be decided with reference to the interests of the mother, as a difficult breech delivery complicated by prolapsed funis offers but a sorry prospect of saving the life of the child.

* Grundlegung zur Hebammen-Kunst, Flensburg and Leipsic, 1756.

† Nederl. Weekbl., April, 1855.

If the membranes rupture and the cord is prolapsed while the cervix is still narrow and rigid, an attempt should first be made to push back the cord with two fingers after placing the woman in the genu-pectoral position. As a rule, however, instrumental replacement will be necessary. I have been in the habit of employing for the purpose, as recommended by Dudan, a large English catheter, which possesses the advantage of forming one of the ordinary properties of the physician. The method of using the instrument is as follows: A piece of tape should first be fastened loosely around the cord, the stylet should then be made to emerge at the eye of the catheter, and a loop of the tape should be placed in the angle it forms. By returning the stylet and pushing it forward to the extremity of the tube, the band is held firmly. After replacing the prolapsed cord, the catheter is readily detached by the withdrawal of the stylet. Braun von Fernwald, who is the author of the best of the repositors made expressly for the prolapsed cord, says that the catheter is almost the only instrument to which he now resorts.

Instrumental replacement is apt to prove a veritable labor of Sisyphus. As one loop is pushed up another comes down, or the entire mass is returned with infinite trouble to the uterus only at once to be projected into the vagina. Roberton has proposed a handy plan for such cases, which certainly merits a trial. It consists in first passing a piece of twine doubled through an elastic catheter, so that the loop makes its appearance at the eye. Through this loop, a loop of the cord should be drawn. The ends of the twine should then be knotted to prevent them from slipping; the catheter should be armed with a stylet, and should be pushed upward into the uterus, carrying the cord with it. After introducing the catheter, the stylet should be withdrawn, and the instrument should be left behind to keep the cord from again prolapsing.

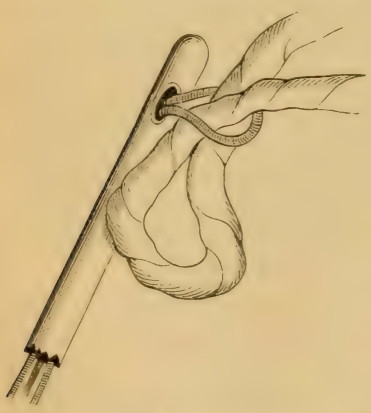


Fig. 231.—Roberton's repositor.

In one case Dr. Ashford* succeeded in attaching the cord to a Gariel pessary. The latter was then carried into the uterus, and inflated to prevent its expulsion.

If neither the cord can be returned nor the child extracted, it is proper to try by Braxton Hicks's method to convert the head presenta-

* F. A. Ashford, 'Ballooning' the Prolapsed Umbilical Cord, Am. Jour. of Obstet., October, 1878, p. 745.

tion into one of the shoulder or, better still, of the breech, in order by so doing to relieve the umbilical vessels from pressure. Of course, if the prolapsed funis is associated with pelvic contraction, the rule heretofore given to consult first the safety of the mother remains the guiding one in practice.

In face presentations version is indicated, as, owing to the imperfect manner in which the face closes the uterine orifice, replacement of the cord is not likely to prove successful. If the opening through which the cord makes its way into the vagina is produced by a prolapsed extremity, the latter, of course, should be pushed back after the cord has been returned. In footling cases the pressure on the cord does not begin until long after the extremities can be reached and utilized for extraction. In full breech cases, where the size of the presenting part might interfere with the funic circulation, where it is possible to return the cord with the hand it is equally practicable to bring down an extremity. In cross-births, before the shoulder becomes wedged in the pelvis the cord is in no danger. No treatment is therefore necessary, except that indicated by the faulty presentation.

Suspended Animation or Asphyxia Neonatorum.

Definition.—The term suspended animation is applied to such grades of congenital asphyxia in the living new-born child as are not incompatible with the continuance of its life. A larger number of males than of females are borne asphyxiated, and the children of primiparæ are more liable to this condition than those of multiparæ.

Etiology.—A perfect comprehension of the etiology of suspended animation must be based upon thorough knowledge of the physiology of intra-uterine life and of the conditions necessary to its preservation.

During the period of gestation the child remains in a state of apnœa, and the respiratory function necessary to its development is performed by the placenta. So soon, however, as the child is born, in normal cases, the thorax expands, the diaphragm contracts, and pulmonary respiration is established. The premature establishment of pulmonary respiration while the child is still in the utero-genital passage, owing to the absence of an atmospheric medium, is followed by asphyxia, and is the usual cause of still-births.

The reason of the first respiratory movement in the child, whether prior or subsequent to its birth, has long been a subject for speculation. Omitting earlier views, at present two theories contend for supremacy. The one formulated by Schwartz maintains that in all cases the respiratory act is due to disturbed placental circulation, and the consequent lack of oxygen in the blood of the child. Preyer, on the other hand, insists that respiration is a reflex movement provoked by cutaneous stimuli. He admits, however, that a venous condition of the blood favors

the action of external stimuli by increasing the irritability of the respiratory centres.

As a contribution to the solution of the questions in dispute, Otto Engstrom * has recently reported a series of experiments made by him upon gravid rabbits and guinea-pigs, in Preyer's laboratory. The animals were strapped to a board, and were then immersed in a saline solution (six per cent), which was kept at blood-heat by a special apparatus. The head of the animal was placed above the fluid. A small incision was then made in the abdominal wall, through which a uterine cornu was allowed to escape into the saline fluid. The uterine walls were next opened opposite the mesenteric attachment at the point of least vascularity. As there was no hæmorrhage to stain the saline fluid, it was possible to observe the fœtuses through the membranes in the clear amniotic fluid. When this experiment was performed with address and dexterity, the exposed fœtus remained in a state of apnœa, and the blood in the umbilical vein possessed a bright-red color, in marked contrast with dark hue of the blood in the umbilical arteries.

If now the cord was compressed through the membranes by the thumb and index-finger of the warmed hand, or by self-closing compressing forceps applied to the cord near to the placenta, and as far from the fœtus as possible, respiration followed in from three to six seconds, and continued until death supervened from asphyxia. The same results followed when the umbilical vein was pricked with a needle, or was divided by scissors. Again, in other cases, to avoid the criticism that external stimuli were not absolutely excluded by the manipulations employed, the mother was asphyxiated by carbonic-acid gas, or poisoned by woorari, or bled to death by opening the carotid. Here, too, soon after the blood in the umbilical vein became of a venous hue, respirations occurred as heretofore, though all manipulations were carefully avoided. It is, therefore, demonstrated that fetal respirations are excited, in the absence of external sources of irritation, so soon as the blood in the umbilical veins becomes darkened, or is cut off from the fœtus.

On the other hand, in another series of cases, where the amniotic sac was exposed under a blood-warm saline fluid, and the apnœa was not disturbed, Engstrom gently pricked the extremities of the fœtus with a needle. Reflex movements were excited, but the apnœa continued. When, however, deep puncture was made, the alæ nasi dilated, the mouth opened, and thoracic inspiration was evoked. The effect was, however, momentary, and the apnœa returned.

Again, in order to reduce the disturbance of the placental circulation to a minimum, Engstrom, following a method invented by Preyer, seized the head of a fœtus with the thumb and index-finger through the abdominal walls, and then cut through the abdominal coverings, the uterine walls, and amniotic sac to the nose of the animal. The nose

* Ueber die Ursachen der Ersten Athem bewegungen.

was then lifted above the saline fluid and exposed to the atmosphere. By means of powerful currents of induced galvanism applied to the nasal organ, respiratory movements were excited, but ceased when the current was removed. It seemed doubtful, however, whether inspiratory acts did occur in either series of experiments so long as the placental circulation was completely undisturbed. The existence of apnœa in the fœtus is not conclusive evidence that the opening of the uterus or the compression of the uterine walls produces no derangement in the blood-currents of the placenta. The results were often negative at the beginning of the experiment, but, as the blood in the umbilical vein darkened, the electric and mechanical irritants produced more and more marked effects.

From these experiments it becomes evident that when the placental respiration is suspended, the accumulation of unknown materials in the blood is capable of exciting the respiratory center in the medulla oblongata of the fœtus without the aid of peripheral stimuli; but that the latter are capable of exciting the respiratory act before the internal stimuli have increased sufficiently to induce independent action. Again, it is a familiar fact that in moderate degrees of asphyxia in the new-born, after the irritability of the medulla has been lowered to a point at which no response follows from the venous condition of the blood, external stimuli are still capable of exciting respiratory movements.

Engstrom found, too, that when the fœtus had breathed in the amniotic sac, after respirations had ceased, and after the blood in the umbilical vein and arteries had become of the same blue color, and the nose and lips had become cyanotic, it was still possible to excite respirations in some cases by opening the amnion and lifting the head so as to expose it to the air, and in others by pinching the nostrils, the ears, and the mouth. For the sake of convenience, I shall take the liberty of recalling at this point the peculiarities of the fetal circulation. The arterialized blood in the umbilical vein empties partly into the portal vein, and is first distributed to the liver, and in part passes by the ductus venosus into the inferior vena cava. The mingled venous and arterial currents then enter the right auricle, and are in early pregnancy directed by the Eustachian valve across the right auricle to the left auricle, and thence pass to the left ventricle. As the heart contracts, the blood is driven from the left ventricle to the aorta, and is thence distributed by the large vessels which spring from the latter to the head and upper extremities. The blood returned from the upper portion of the body by the superior vena cava enters the right auricle, where it passes in front of the Eustachian valve to the right ventricle. With the advance of gestation, however, a gradual disappearance of the Eustachian valve takes place, so that a part of the blood from the inferior cava enters with that of the superior cava into the right ventricle. The contraction of the right ventricle forces the blood into the pul-

monary artery, which distributes an insignificant quantity to the lungs, while the main current passes through the ductus arteriosus to the aorta, by which it is distributed to the lower portion of the body. Now, though the greater part of the regenerated placental blood is distributed to the head and upper part of the body, it is mingled largely with venous blood returning from other organs, and that which goes to the respiratory center in the medulla oblongata is of a character which would cause dyspnœic manifestations in self-breathing individuals.

During labor, especially in the last stage, the placental aëration of the blood is interfered with by the uterine contractions, and in its passage through the pelvis the surface of the child is subjected to pressure and friction. At birth the body is exposed to the air. These combined causes as a rule are followed by pulmonary respiration, though in some instances of lowered irritability of the medulla prolonged apnœa follows the birth unless the child is made to cry by vigorous slapping.

As the chest expands in the act of inspiration the lungs fill with air, and the blood from the pulmonary artery pours into the opened pulmonary vessels. The pressure in all the vessels of the body is diminished, though in the thorax a partial compensation takes place from the aspiration of blood from the veins which enter the intrathoracic space. The diminution of pressure is greatest in the pulmonary artery. The current which empties into the aorta becomes of feeble force, and finally ceases altogether. The ductus arteriosus gradually closes, and the pulmonary circuit becomes complete. The withdrawal of the blood from the pulmonary artery and the force of aspiration lower the tension in the aorta. The heart beats more slowly. The resulting diminished arterial pressure is most felt in the extremities. The pulsation of the umbilical arteries as a consequence ceases, and the placental circulation is suspended.

In the asphyxia of new-born infants the suspended animation is, with few exceptions, preceded by intra-uterine respirations. The causes of the latter are to be found in tetanic contractions of the uterus and the consequent diminished blood-supply to the placenta, in premature detachment of the placenta, in compression of the cord, in acute anæmia, and in the sudden death of the mother. Of these, the compression of the cord is by far the most common.

The first effect of the compression of the cord is to arrest the circulation in the umbilical arteries. The pressure in the aorta is thereby augmented, and increased work is thrown upon the left ventricle of the heart. Except in cases where the mouth and nasal passages are closed by pressure, with the expansion of the chest, due to the irritation of the medulla by the increased venosity of the blood, amniotic fluid, meconium, and mucus are aspirated into the air-passages. When the compression of the cord is temporary the circulation may be restored, and

the apnœa may again return; but in cases where the respirations continue, the capillaries of the lungs fill with blood from the pulmonary artery, the intrathoracic venous congestion is increased, and the heart action is lowered. As the irritability of the medulla sinks, the respirations fail, the cavities of the heart fill with venous blood, the lungs are congested, and in some instances subpulmonary ecchymoses result from overdistention of the pulmonary vessels. Outside the thoracic cavity, the venous trunks are often distended with blood. This secondary venous stasis is most marked in the vessels of the neck, head, and brain, but to a less degree venous stases are likewise observed in the abdominal organs and in the capillaries of the skin.

Suspended animation may exceptionally occur without antecedent intra-uterine respiration. This is the case when disturbance or arrest of the placental functions takes place in fœtuses so immature that their medullary centers can not respond to the irritation of insufficiently oxygenated disassimilative products by originating the nervous impulse necessary for the production of respiratory movements. Another cause of suspended animation unattended by intra-uterine respiration is, according to Schultze, a very slow progress of the placental respiratory disturbance, and a conseqnent gradual diminution of the amount of oxygen in the fetal blood. The deficiency in oxygen is at first so slight as not to stimulate the medullary center, and when the deficiency becomes more marked, the irritability of the medulla has been so much depressed that it is no longer capable of originating a respiratory impulse. In this case the fœtus dies or passes into a condition of suspended animation without having breathed at all.* Compression of the fetal brain due to a contracted pelvis, to intracranial hæmorrhage, to the use of the forceps,† or to delivery in breech positions, may occasion death or suspended animation without exciting respiratory movements. The rationale of such cases is as follows: Cerebral compression reduces or even arrests the heart's action by irritating the pneumogastric nerve. The placental respiratory function is thus impaired, the fetal blood is consequently deprived of oxygen, and the irritability of the medulla so reduced that the latter can no longer originate respiratory movements.‡ If intracranial extravasations are located upon the convexity of the cerebrum, they are comparatively innocuous, since the medulla is not compressed. Their most pernicious effect is naturally observed when they are situated at the base of the brain.

Morbid Anatomy.—Schultze recognizes two stages of suspended animation, which correspond to the terms *asphyxia livida* and *pallida*, usually employed to designate these respective conditions.# The

* Schultze, *op. cit.*, pp. 102 *et seq.*

† Dohrn, Arch. f. Gynæk., Bd. vi, 1874, p. 365.

‡ Frankenhäuser, Monatsschr. f. Geburtsk., Bd. xv, 1860, p. 368.

Schultze, *op. cit.*, pp. 6, 130, 147.

boundary line between the two stages is marked by the loss, on the part of the muscles, of their tonic contractility. In the first stage the muscular tone is still preserved. Although there are no spontaneous muscular contractions, the extremities are not completely relaxed, nor does the head drop. Reflex movements are easily produced by surface irritation. The skin is dusky red or cyanotic, the cutaneous vessels are turgid, the conjunctivæ injected, and the eyeballs protruding. The cardiac and umbilical pulsations are slow but forcible. The umbilical vessels are fully distended. Respiratory movements usually occur only after a certain interval. They are at first feeble, superficial, and attended by facial contortions, but soon become more powerful. The increased deficiency in oxygen, occasioned by delivery, often furnishes to the medulla, in this stage of suspended animation, a stimulus of sufficient intensity to cause spontaneous respiratory movements. The same result is attained by irritation of the surface. If respiration does not ensue from either cause, the child passes into the second stage of asphyxia.

In the second stage of suspended animation, or *asphyxia pallida*, the children are exceedingly anæmic. The conjuctivæ are without luster; the surface is cold; the sphincters are relaxed; the limbs, head, and lower jaw hang loosely down. Reflex movements do not occur. The cardiac beats are frequent and feeble. The umbilical pulse is almost or quite imperceptible. The umbilical vessels are empty. Either no spontaneous respiratory movements occur or they are few, snapping, and produced by the diaphragm, without the participation of the facial, nasal, or maxillary muscles. The respirations are ineffectual, since a *post-mortem* examination reveals little or no air in the bronchi, which are usually filled with fluid matter, and since no râles are heard during the respiratory efforts. The medulla is so completely paralyzed that the stimulus of the increased deficiency in oxygen, attendant upon delivery, merely produces these futile respiratory efforts. Should artificial means succeed in restoring the child, the first signs of its resuscitation will be refilling of the cutaneous capillaries and returning muscular tonicity. The morbid anatomical features of suspended animation vary according as that condition has or has not been attended by intra-uterine respiration. In the latter case the blood is dark and uncoagulated. The pulmonary vessels are widely distended. The lungs are enlarged, heavy, and of a dark-red color. Numerous pulmonary, subpleural subpericardial, and subendocardial ecchymoses are present. The pulmonary extravasations are more extensive than in cases of asphyxia accompanied by intra-uterine respiration, for the reason that, in the latter, the aspirated fluids offer a certain support to the distended capillaries. Pulmonary congestion and ecchymosis may be absent if the inspirations were ineffectual, infrequent, and of short duration. The obstruction of the pulmonary

circulation further produces venous congestion of the surface, of the abdominal organs, and of the encephalon resulting in subconjunctival, meningeal, and cerebral hæmorrhages. Ecchymoses may also be found beneath and upon the pericranium. Aside from the extravasated blood, no foreign matters are found in the bronchi. The absolute proof that the asphyxia of still-born children, or of those born in a moribund condition, was attended by intra-uterine respiration consists in the discovery, within the bronchi, of substances introduced by thoracic aspiration. When the proof is lacking, inspiration may still have occurred, but the entrance of foreign bodies has been prevented through occlusion of the nose and mouth by portions of the membranes, or by close appositian to them of the maternal soft parts. The quantity of aspirated material will depend upon its character and the force of the inspirations. The tough cervical mucus penetrates only to the trachea and primary bronchi. The liquor amnii, containing meconium, vernix caseosa, and blood and downy hairs, may even reach the terminal bronchioles. If air had found an entrance into the uterine cavity, it is also present in the bronchi, and, exceptionally, in the stomach and duodenum. The dilatation of the Eustachian tubes, as a consequence of the first inspirations, permits, in some instances, according to Wendt,* the penetration of liquor amnii into the middle ear. The pulmonary ecchymoses are less numerous and extensive in asphyxia attended by intra-uterine respiration than in the other variety, for reasons above stated, but congestion and extravasations in the abdominal and cerebral organs are quite as constant and important.

Diagnosis.—An important diagnostic symptom of beginning asphyxia is diminished frequency of the fetal heart-beats, due to inhibition of the placental respiration. This has no significance if it be manifest only during the pains, since it is then a physiological occurrence due to the mechanical compression of the fœtus or to expression of the placental blood into the fetal vessels. If it persist, however, during the interval between the pains, and be progressive, it is of serious import, betokening either considerable compression or irritation of the medulla by an excess of deoxygenated blood. The diminished frequency is sometimes succeeded by increased rapidity of the cardiac contractions, indicating paralysis of the pneumogastric, and, consequently, a more advanced stage of suspended animation.† This increased rapidity is, probably, invariably preceded by the diminished frequency of the heart's action already alluded to. The evacuation of meconium is also diagnostic of asphyxia, provided it be not merely the result of the mechanical compression exerted upon the child in breech presentations. The appearance of the meconium is, probably, due to the increased intestinal peristalsis attendant upon asphyxia, although,

* Spiegelberg, Lehrbuch, p. 667.

† Hüter, Monatsschr. f. Geburtsk., Bd. xviii, 1862, Supplem. Heft, p. 48.

perhaps, in part occasioned by relaxation of the sphincters and compression of the abdomen by the contracting diaphragm. The discharge of meconium, accordingly, usually attends that form of suspended animation in which intra-uterine respiration has occurred, and is absent in those cases of gradually induced asphyxia unaccompanied by respiratory efforts. The differential diagnosis between these two varieties is completed, after delivery, by the detection of bronchial râles, due to the aspiration of intra-uterine fluids, in all cases of intra-uterine respiration except those in which the external air-passages were occluded. The discharge of meconium is sometimes not indicative of any pathological condition. Schultze * detected intra-uterine respiration by abdominal auscultation, as well as by intra-uterine palpation, and numerous observers have heard the *vagitus uterinus*, or intra-uterine cry, which bears testimony to the entrance of air into the uterus, and to the occurrence of respiratory movements. † When delivery has been partially accomplished, the diagnosis of asphyxia is easily made from the failing fetal pulse, the cyanosis, the forcible respiratory efforts, and the relaxation of the child's muscles.

Prognosis.—The prognosis depends largely upon the grade of the asphyxia, although the cause of the latter is of still greater significance. Suspended animation which is not accompanied by intra-uterine respiration offers the best prospects for resuscitation. The chances are smaller if inspiration has occurred, and the worst prognosis is afforded by the occurrence of respiration when the nose and mouth are occluded, on account of the graver derangement of the fetal circulation, and the more abundant pulmonary extravasations. The presence of aspirated foreign substances clouds the prognosis by interfering with efforts at artificial respiration, and by acting as the exciting cause of atelectasis and of lobular pneumonia. The prognosis is also rendered grave by the occurrence of intracranial hæmorrhages. The mortality of asphyxiated children in the first eight days after delivery is, according to Poppel's statistics,‡ seven times greater than that of children born unasphyxiated, and the mortality in the first week in direct proportion to the duration and gravity of the suspended animation.

Treatment.—The indications for treatment are in all cases to clear out the air-passages, to restore the irritability of the medulla, to increase the force of the heart-contractions, and to relieve the plethora of the heart and of the blood-channels of the thorax.

In cases where the muscular tonus is preserved these indications are, as a rule, easily fulfilled; aspirated fluids and mucus should be cleared

* Schultze, *op. cit.*, p. 127.

† Kristeller, Monatsschr. f. Geburtsk., Bd. xxv. 1865, p. 321; Bartscher, *Ibid.*, Bd. ix. 1857, p. 294; Mayer, *Ibid.*, Bd. xxv, 1865, p. 341.

‡ Poppel, *op. cit.*, p. 57.

from the fauces with the finger. If the nasal passages are obstructed, mouth-to-mouth insufflation should be employed. The child should be made to cry by flagellation, and the respiratory movements should be further stimulated by alternately immersing the child in hot and cold water. So far the procedure is a familiar one, but in a good number of cases we know that in a few days the skin becomes dusky, the heart action feeble, and the child has been temporarily restored to life only in the end to die of atelectasis. As a means of guarding against this fatal sequence, due in part to imperfect expansion of the lungs, in part to lobular congestion, there is no method that rivals the one of Schultze.

Schultze directs that the child should be grasped in such a manner that the operator's thumbs rest, on either side, upon the anterior thoracic wall, while the index-finger occupies the axilla, and the remaining fingers are placed diagonally across the back. The child is then allowed to hang at arm's length between the knees of the obstetrician, its face being turned to the front. In this position the pectoral muscles are made to draw the superior ribs upward, the abdominal muscles draw the inferior ribs downward, and the weight of the liver causes the descent of the diaphragm. By this means the capacity of the chest is increased, and inspiration is produced. The child is next swung upward, until the arms of the operator reach an almost horizontal position. The swinging motion is then arrested, flexion occurs in the child's lumbar spinal region, its head is directed downward, and its lower extremities fall slowly toward the obstetrician until the whole weight of its body rests upon his thumbs. In this way the chest and abdomen are powerfully compressed, the diaphragm is forced upward, and an efficient expiration results, and any retained adventitious matters are expelled from the air-passages. An inspiration is now produced by reversing the direction of the swing and returning the child to its former position of complete extension, by which manœuvre the chest is made to expand and the diaphragm to descend.

By this method not only is good aëration of the lungs secured, but the forcible expiration expels the materials aspirated from the bronchial tubes. A still more important action, according to Schultze, is the relief of the overloaded vessels as a result of the compression of the entire thoracic contents. Thus, as expiration is produced by the upward swing, the blood is pressed from the left ventricle into the aorta, and from the right auricle into the right ventricle. The emptying of the left ventricle makes room for the contents of the left auricle, and permits the return current from the pulmonary veins. From the right ventricle the surplus blood finds a passage into the aorta through the ductus arteriosus. With the inspiratory swing blood is aspirated from the peripheral vessels into the blood-channels of the thorax. The aspirated blood is, however, venous, as the semilunar valves prevent re-

gurgitation from the aorta. By alternating the expiratory and inspiratory swinging movements the pump-working of the heart is mechanically set in action. As the blood-streams pass through the heart cavities, the systole increases in force and the arterial tension is restored.

In cases of deep asphyxia, in which muscular tonicity is lost, and the heart movements are scarcely perceptible, the methods at first employed should involve the minimum degree of disturbance to the child. Active movements are, as a rule, speedily followed by the extinction of heart pulsations.

The child should be laid upon a table and covered warmly. After clearing the fauces and nasal passages a No. 8 English elastic catheter should be passed, under the guidance of the fingers of the left hand, through the larynx into the trachea, and aspirated matters should be carefully removed by suction. Meantime, at intervals insufflations through the tube into the bronchial tubes should be employed. After each insufflation the chest walls should be compressed with the hand, to produce expiration. By this means, little by little, the blood receives oxygen, and the returning irritability of the medulla is manifested by occasional spontaneous respiratory movements. When the color returns to the skin, and the heart's action is restored, artificial respiration should be maintained, at first by means of Sylvester's method, which is preferable to that of Schultze in feeble children, as it involves less exposure and less violent manipulations. In Sylvester's method * the child is placed upon its back with the shoulders raised sufficiently to prevent the chin from falling forward on the breast. The tongue is drawn forward to maintain a free entrance of air into the windpipe. To imitate the movements of deep inspiration, the operator grasps the arms above the elbows, and, raising them upward by the sides of the head, he extends them gently and steadily upward and forward for a few moments. At the same time the feet should be fixed. According to Champneys, the effect produced is more than twice as great when the arms are everted as when the arms are inverted. This he attributes to the mode of insertion of the pectoralis major muscle into the outer lip of the bicipital groove, eversion naturally rendering this more tense. Expiration is effected by turning down the arms and pressing them gently but firmly against the sides of the chest. When the process has been repeated a few times, the warm bath should be employed to prevent undue refrigeration of the cutaneous surface. The method described should be alternated with the baths until spontaneous respiration is maintained or the case be-

* Sylvester. The Discovery of the Physiological Method of inducing Respiration in Cases of Apparent Death from Drowning, Chloroform, Still-birth, Noxious Gases, 3d ed., 1853; The True Physiological Method of restoring Persons Apparently Drowned or Dead, and of resuscitating Still-born Children, London, 1858.

comes hopeless. As the circulation improves, the swinging movements of Schultze may often be employed with advantage. In prematurely delivered asphyxiated children these methods are inapplicable, since the thoracic walls are so yielding as not to undergo the changes of form requisite to the success of the methods described. In such cases insufflation, through the catheter, following aspiration, of the foreign bodies in the air-passages, is the only available treatment. If the efforts at resuscitation be successful, the child must, for the first few days after its birth be kept particularly warm and be regularly nourished.*

Collapse and Sudden Death during Labor and Childbed.

We have already had frequent occasion to mention collapse during or following labor as a sequence of hæmorrhage, or of injuries to which the genital passages have been subjected. Syncope is not an uncommon result of exhaustion following prolonged labor, or even normal labor in women with exceptionally sensitive nervous organizations. Again, it may be caused by the cerebral anæmia produced by the recession of blood from the nerve-centers when the intra-abdominal pressure is suddenly diminished by the rapid emptying of the uterus. Temporary syncope, if followed by complete restoration of the normal circulation, has no positive prognostic significance. Where, however, the pulse continues feeble and rapid, it should be, even in the absence of other grave symptoms, a subject of profound concern. The arteries then gradually become empty, while the large venous trunks fill with blood, and the sluggish current predisposes to the formation of thrombi.

Apart from such rare accidents as cerebral apoplexy, or heart rupture, or fatal endings from hæmorrhage, from pulmonary congestions and œdema, from eclampsia, from inversion and rupture of the uterus, and acute septicæmia, the causes of sudden death are to be found in pulmonary embolism, in the entrance of air into the circulation, and in shock.

On Thrombosis and Embolism.—Thrombi owe their importance to the disposition they possess to disintegrate and form emboli, which are swept along by the circulation until arrested by the diminished caliber of the peripheral vessels. A small clot forming in the left side of the heart may block up an artery in the brain or in either an upper or lower limb. The symptoms of the lesion in the latter case are the absence of pulsation in the artery below the thrombus, with pain, coldness of the surface, paralysis of the nerves of motion and sensibility if the

* The substitution of Sylvester's method for those of Marshall Hall and Schroeder, as given in the first edition of this work, is due to the very careful and satisfactory investigations of Francis Henry Champneys in reference to the amount of ventilation secured by the different methods of artificial respiration. (Med.-Chir. Trans., vol. lxiv.)

arterial obstruction be sudden and complete, and in some cases gangrene of the extremity affected.*

Of much more common occurrence are venous thrombi. Indeed, it may be stated that thrombosis of the veins furnishes the most frequent cause of sudden death in labor and during the puerperal period. As a rule, the clotting takes place in the femoral, the pelvic, or the uterine veins. Spiegelberg† states that the emboli which become detached during or shortly after labor proceed from clots formed at the site of the placenta.

When the placenta is partially detached during labor, or the uterus does not properly contract after the birth of the child, sudden hæmorrhage, followed by syncope or marked weakening of the heart's action, may lead to the formation of large, soft clots, extending from the open mouths of the sinuses in the direction of the heart. These, by sudden movements, by the douche, or under a powerful contraction, such as oftentimes follows the rupture of the membranes or the expulsion of the fœtus, may be set adrift from their moorings, and be washed upward through the vena cava to the right side of the heart, and thence to the branches of the pulmonary artery.

It has been assumed, though not without question, that, owing to the large proportion of fibrin in the blood during pregnancy and childbed, it is possible, when the heart's action is feeble, for spontaneous coagulation to take place in the pulmonary artery. This theory, originally broached by Meigs, has been warmly supported by Playfair and Barker. Clinically, many striking facts have been adduced in its support. Playfair argues that, when dyspnœa precedes phlegmasia dolens, the same causes which have led to thrombosis of the femoral veins have antecedently been at work in the formation of coagula in the pulmonary artery. But the *post-mortem* evidence of such a connexus is not conclusive. Dr. Mary Putnam Jacobi has reported the case of a patient, dying five hours after labor, where præcordial oppression and dyspnœa had been marked, and yet no lesions whatever were found at the autopsy to account for these symptoms. Nor is it possible, when we consider the frequency with which thrombosis of the uterine veins precedes that of the veins of the thigh, to be sure, in the absence of a *post-mortem* examination, that the dyspnœa observed by Playfair may not have been due to an embolus from a clot formed in a uterine vessel. I would not, however, deny the possibility of Playfair's hypothesis. I only wish to emphasize the fact that, so far as the evidence goes, it lacks the positiveness of a scientific demonstration. According to all ordinary experience, the force of the blood-current in the pulmonary artery, except in the death agony, is sufficient to prevent spontaneous

* Barker, The Puerperal Diseases, p. 257; Barnes, Thrombosis and Emboli of Lying-in Women, Obst. Trans., vol. iv, p. 30.

† Spiegelberg, *loc. cit.*, p. 661.

coagulation from taking place. Virchow has, however, pointed out that any of the few minor veins opening into the right auricle may be the seat of the primary thrombus, and give rise to a large secondary thrombus within the auricle. (Savage.)

The symptoms of stoppage in a large pulmonary vessel are intense dyspnœa, air-hunger (to use an expressive German term), fluttering heart-action, a feeble, rapid pulse, a cold skin, and striking pallor of the countenance. Death may follow in a few minutes, or, where the main trunk is free, the more violent symptoms may in the course of a half-hour subside, to return, however, with the slightest movement or without apparent cause, the patient dying in a few days from abnormal lowering of the temperature, from dyspnœa, and cyanosis; or, after a succession of attacks, the thrombus may be absorbed, and, as I have once seen, complete recovery may take place.

The Entrance of Air into the Circulation.*—The passage of air from the uterine cavity into the circulation is rendered possible by the presence of open sinuses, or of sinuses closed by soft, easily detached thrombi. These conditions are always present previous to delivery in case of partial separation of the placenta, and in the puerperal state, especially in the latter, when, owing to debility resulting from the undue prolongation of labor, the expulsion of the ovum has been followed by imperfect retraction.

Air may be forcibly driven into the uterus by means of the uterine or even the vaginal douche. For this reason the siphon syringe should be discarded from midwifery practice. The objection to the continuous stream furnished by a vessel placed at a height above the patient, based upon the insufficient force of the current, is purely theoretical.

It is not necessary that the nozzle of the syringe should be introduced directly into the uterine cavity for accidents to occur. Wiener† has reported from Spiegelberg's clinic a case where collapse followed the use of the vaginal douche, though the tube was free from air, the hydrostatic pressure having forced air which had previously entered the vagina up into the uterus. When, therefore, the douche is employed to induce premature labor, the stream should at first be propelled gently, and the vulva should be parted to permit the egress of contained air.

Less familiar than these cases of forced air injection are well-accredited instances of spontaneous entrance of air into the uterine sinuses. This accident is rendered possible by the diminution of the intra-abdominal pressure in certain body postures. Of these, the three familiar to us through gynæcological experiences are, respectively,

* *Vide* Kezmársky, Ueber Lufteintritt in die Blutbahnen durch den puerperal. Uterus. Arch. f. Gynaek., vol. xiii, p. 200.

† Wiener, Zur Frage der künstlichen Frühgeburt bei engem Becken, Arch. für Gynaek., vol. xiii, p. 94.

the knee-chest, the latero-prone, and the lithotomy positions. In childbirth, under favoring conditions, the sudden rupture of the membranes which had previously distended the vagina, or the rapid extraction of the child, may be followed by the ingress of air into the uterus itself, in some cases doubtless the recession of the uterus after its evacuation favoring the occurrence of the accident. The entrance of air into the uterus does, of necessity, do harm, or the harm may be limited to the production of endometritis; still there are recorded cases where the aspiration of air has been followed by almost instant death.

The *post-mortem* examinations of cases of death from air entering the uterine sinuses show but little blood in the left side of the heart; frothy blood from the cut surfaces of the uterus; air in the uterine veins, the vena cava, the right side of the heart, and at the orifice of the pulmonary artery; the lungs anæmic, and containing frothy serum; the brain pale and infiltrated with serum.

Corresponding to these anatomical conditions, the hands during life were cold, the pulse scarcely perceptible, the face blue and livid, consciousness was lost, and the respirations were labored and jerky, with all the symptoms of intense dyspnœa.

Nerve Exhaustion and Shock.—Twenty years ago these pathological states played a conspicuous part in the etiology of sudden death during childbirth. Now the fashion has changed. Such terms as "nervous apoplexy" and "idiopathic asphyxia," which were employed as synonymous expressions, belong to an almost forgotten nomenclature. None the less the need remains to account for a class of cases in which death takes place without recognizable organic lesions.

Instances of death attributed to heart paralysis are to be found in the collections of McClintock * and Mordret; † but to these objections have been made, either that the *post-mortem* confirmation of the diagnosis was lacking, or that the examination was lacking in the completeness necessary to shut out other possible causes of death. Baart de la Faille,‡ however, has more recently collected thirteen cases of collapse in which the occurrence of embolism and the entrance of air could with every probability be excluded. Cases where the absence of all symptoms of pulmonary obstruction furnish certain evidence that neither of these causes was operative may be found scattered through medical literature.#

In the absence of visible lesions, or the characteristic symptoms of the conditions to which death in childbed is usually referred, we have

* McClintock, Dublin Med. Press, 1852.

† Mordret, Mem. Acad. Med., 1858.

‡ Baart de la Faille, *vide* Synopsis Monatsschr. für Geburtskunde, vol. xxv, p. 318.

Vide case reported by O. T. Schultze in American Practitioner, April, 1884, likewise author's paper on Sudden Death in Labor and Childbed, Journal of the American Med. Assoc., for recent examples.

the right to attribute the melancholy issue to the same causes which, outside of childbed, produce identical phenomena. In the torpid form of shock the features are pinched, the eyes sunken and surrounded by dark rings, the skin possesses a marble pallor, the hands and lips are blue, the extremities are cold, sweat stands upon the brow, the pulse is thready and scarcely perceptible, while, in contrast to cases of pulmonary obstruction, the breathing, though it may be shallow, is not difficult or labored, and, in spite of the extreme prostration of the physical forces, the sphincters remain closed, and both consciousness and sensibility are preserved. Sometimes these earlier symptoms are followed by a stage of excitement in which the face, with the exception of the mucous membranes, becomes reddened, the eyes grow bright, the patient becomes restless, complains of constant thirst, and bids her friends farewell in anticipation of speedy death; but, in spite of the reviving color, the pulse continues too rapid to be counted, the skin never regains its normal temperature, and the hopes of speedy restoration to health are dashed by the gradual or sudden suspension of the beatings of the heart.

Modern pathological investigation refers the phenomena of shock to a reflex paralysis of the vaso-motor, and especially of the splanchnic nerves, whereby the great mass of the blood is withdrawn from the surface, and collects in the trunks of the cœliac, the mesenteric, and the renal veins. Hence, the skin becomes cold, and is devoid of color save at the points where a bluish hue is imparted by the stagnant blood still lingering in the veins; the muscles, deprived of blood, feebly respond to the impulses of the will; the empty vessels of the brain explain the sluggish intelligence, the nausea, the vomiting, and the indifference of the patient; and, finally, during the diastole, the heart, pale and contracted, receives but little blood, and the radial pulse fades to nothingness because of the corresponding small amount of fluid propelled during the systole into the arterial vessels.*

From works on military surgery we learn that it is in the defeated army, among homesick soldiers, at the close of a wearisome war, after great exertions and deprivations, that shock is developed in its severest forms; that the finer the organization, the more readily the manifestations occur; that they are promoted by sudden losses of blood, and are in a special degree evoked by abdominal injuries.

It certainly would be singular if similar conditions in childbed were not followed by similar results. After labor, the nervous system of the woman is depressed by pain, starvation, and loss of sleep. The sudden emptying of the uterus is followed by a recession of blood from the head to the venous trunks of the abdomen. Hæmorrhage, followed by weakening of the heart's action, tends still further to increase the venous stasis. In the old days of torture, shock often mercifully put

* Fischer, Ueber den Shok, Volkmann's Samml. klin. Vorträge, No. x.

an end to the victim's anguish. Women in childbirth are at times subjected to pain exceeding that of the rack and the thumbscrew; and the wonder is not that the circulation should occasionally show signs of marked and even fatal disturbance, but that the nervous system, attacked from so many directions, should, in the rule, triumph over the adverse forces.

Treatment.—The treatment of pulmonary embolism, whether due to air or a disintegrated thrombus, is necessarily for the most part prophylactic. The proper precautions for avoiding the accidents described are sufficiently indicated in the preceding discussions as to their etiology. It is proper to remember that the nervous organization of woman loses in powers of resistance as the penalty of a higher civilization and of artificial refinement, and that it becomes, therefore, imperatively necessary for the physician to guard her from the dangers of excessive and too prolonged suffering. Especially I would raise my voice in warning against the current opinion that the length of the first stage of labor before the rupture of the membranes is a matter of indifference. In pulmonary embolism the violence of the symptoms at the outset of the attack is often out of proportion to the real gravity of the lesion. A small embolus or air entering the lungs, finely subdivided, may produce symptoms of dyspnœa which may be of temporary duration. In all cases, therefore, warmth should be applied to the surface, and every effort should be made to maintain the action of the heart. To this end injections of ether beneath the skin, and of ammonia into the veins, are to be counted as most powerful adjuvants. In shock, opium, atropia, and digitalis are theoretically indicated, and yet large doses of the latter drug, as have been sometimes recommended, are not unattended with risk, and may precipitate the final catastrophe.

Extraction of the Child in Case of Real or Apparent Death of the Mother during Pregnancy or Labor.

Death of the mother during pregnancy or labor may be threatened, or may actually result, either suddenly or slowly, from various morbid conditions which have been previously considered. Although sudden death of the mother is more frequent at the time of delivery, in consequence of hæmorrhage, exhaustion, eclampsia, or rupture of the uterus, it may occur at any time, particularly when due to pulmonary and cardiac affections, or to cerebral embolism.

It is our present object to consider the methods of treatment best adapted to the preservation of the child's life in those cases necessarily attended by death of the mother, and to the preservation of both mother and child whenever there is any probability of such a result. Our inquiry may therefore be limited to those cases in which the child is unquestionably living, and its viability undoubted. While the

majority of recent authors upon this subject have recognized the propriety of adopting prompt measures for the immediate extraction of the child after the mother's decease, the same unanimity has not prevailed either in regard to the propriety of operative interference *before* the mother's death, or as to the most appropriate methods of operation. Schroeder * is content with the statement that, in case of maternal demise during parturition, efforts should be made to extract the fœtus *per vias naturales* by version or the forceps. In the event of failure to accomplish delivery by this method, he advises immediate resort to the Cæsarean section. Spiegelberg † recommends the Cæsarean section for all cases of maternal death, excepting those occurring in the second stage of labor, as the surest method of preserving fetal life. He makes no provision for those cases in which the mothers are apparently dead, although actually in a state of syncope or asphyxia. Both he and Max Runge ‡ recommend the Cæsarean section, even in cases of impending death of the mother, in the child's interest, and disparage efforts at extraction through the natural passages. Duer * concludes (*a*) that no operative procedure should be undertaken until there is absolute certainty of the mother's death; (*b*) that, death of the mother being assured, the Cæsarean section should be performed with dispatch if the fetal head be above the pelvic brim; (*c*) that, if the head have engaged in the brim, the question of resort to the Cæsarean section or to extraction *per vias naturales* becomes debatable. He condemns the practice advocated by Rizzoli and Esterle, of resorting to forced delivery when the mother's death is imminent.

One of the most recent and comprehensive articles on the subject of artificial delivery *per vias naturales* is that of Thévenot,‖ who, referring its original introduction to Schenk and Rigaudeaux, and its development to Rizzoli, Heymann, and Depaul, ardently advocates its adoption, to the exclusion of the Cæsarean section. This method he declares to be applicable (*a*) to those cases with normal pelvic conformation in which the mother is dead, the labor somewhat advanced, the os dilated or dilatable, and the head at the superior strait; (*b*) to cases in which labor was only commencing, or had not begun at the time of death; (*c*) to cases frequently occurring, according to the author, of apparent death of the mother (her real condition being that of syncope), whether labor had or had not begun at the time of her apparent decease; and (*d*) to cases of impending maternal death. Thévenot's arguments in favor of the method of treatment under consideration

* Schroeder, Lehrbuch, p. 712. † Spiegelberg, Lehrbuch, p. 269.

‡ Max Runge, Ueber die Berechtigung des Kaiserschnitts an der Sterbenden und der mit ihm concurrirenden Entbindungs-Verfahren, Ztschr. für Geburtsk. und Gynaek., vol. ix, p. 245. * Duer, Am. Jour. of Obstet., January, 1879, p. 10.

‖ Thévenot, De l'acc. artif. par les voies nat. substit. à l'opération césar. *post-mortem*, Ann. de Gynéc., tome x, October, 1878, p. 257; November, 1878, p. 339; December, 1878, p. 412.

are, that the operation may be more promptly resorted to than the Cæsarean section, the preparations for and hesitations about which frequently occasion fatal delays; that it is of less vital importance that the death of the mother be positively ascertained than in cases of Cæsarean section; that it is a less repulsive proceeding; that the results are better than in the Cæsarean section; that the method is not productive of medico-legal complications; and that it affords a numerous class of parturient women, who are only apparently dead, a far better chance of recovery than does the Cæsarean section. Thévenot cites fifteen cases of *accouchement forcé* employed upon women at the point of death, in which thirteen infants were alive at birth, and six lived permanently. Five of the fifteen mothers, who were apparently moribund, recovered, and in three other cases the original diseases were retarded, and their most distressing symptoms temporarily relieved.

Tympanites Uteri.—If air enters the uterine cavity previous to the birth of the child, the dangers are not confined to its passage into the venous circulation. Even when this latter accident does not occur, the patient's condition in a lingering labor is perilous in the extreme. The essential condition for the admission of air is rupture of the membranes. As a result in many though not in all cases untimely respiratory efforts are excited in the child. In very rare instances it is said that the cry of the child, *vagitus uterinus*, has been heard within the uterus. Death speedily follows premature respiration, and, under the combined influence of air, heat, and moisture, decomposition rapidly develops.* The gases generated by putrefaction are sometimes of enormous volume, and the uterus furnishes a tympanitic resonance upon percussion. As a result of prolonged labor, of the distention of the uterine walls, and of septic poisoning, the pains become feeble and the patient suffers from dyspnœa, owing to the pressure upon the diaphragm by the enlarged uterus and the colon, which likewise is found distended with gases. A stinking discharge, sometimes mingled with gas-bubbles is always present.

The prognosis depends upon the intensity of the process and the length of time allowed to elapse before operative measures are employed to remove the source of danger. Of sixty-four women, according to Staude's report, thirty-two died, eighteen had severe puerperal affections, and only fourteen recovered without further complications. The indications for treatment are, to extract the child as soon as practicable when air has once entered the uterine cavity, to wash out the uterus with disinfectant fluids, to use all available means to secure continued retraction of the uterus, and follow every antiseptic precaution during the puerperal period.

* Staude found putrefactive changes developed in fœtuses born from three to twenty-one hours after the access of air to the uterus. Ueber den Eintritt von Luft in die Gebärmutter, Ztschr. f. Geburtsh. und Gynaek., Bd. iii, p. 204.

DISEASES OF CHILDBED.

CHAPTER XXXV.

PUERPERAL FEVER.

Definition.—Frequency.—Morbid anatomy.—Endometritis and endocolpitis.—Metritis and parametritis.—Pelvic and diffused peritonitis.—Phlebitis and phlebothrombosis.—Septicæmia.—Earlier views concerning the nature of puerperal fever.—The nature of puerperal fever as regarded from the standpoint of modern investigation.—General symptoms.—The symptoms of endometritis and endocolpitis; of parametritis and perimetritis; of general peritonitis; of septicæmia lymphatica; of septicæmia venosa; of pure septicæmia.

Definition.—Puerperal fever is an infectious disease, due, as a rule, to the septic inoculation of the wounds which result from the separation of the decidua and of the placenta, and from the passage of the child through the genital canal in the act of parturition.

To maintain this definition it is, however, necessary to group by themselves cases of childbed fever dependent upon causes which are operative in the non-puerperal condition, though the latter imparts to those causes oftentimes an exceptional activity and virulence. In this category are to be placed especially scarlatina, typhus, typhoid, and malarial fevers. It is to be borne in mind that the zymotic fevers may provoke in the puerperal woman the same inflammatory lesions commonly associated with puerperal fever.* This is in accordance with the well-known surgical experience that a febrile paroxysm from any cause exerts an unfavorable influence upon a wounded surface.

Like all brief statements, the writer is well aware that the foregoing definition is necessarily imperfect, and stands in need of further limitations to meet the requirements of exactness. Exceptions, however, either apparent or real, will be noted hereafter in their proper connections.

Frequency.—In a careful search through the records preserved by the Health Department of New York city, I found that from 1868 to 1875, inclusive, the total number of deaths for nine years was 248,533. Of these, 3,342 were from diseases complicating pregnancy, from the accidents of child-bearing, or from diseases of the puerperal state; or, in other words, 1 : 75 of all the deaths occurring during that period was

* Hervieux, Traité clinique et pratique des maladies puerpérales, pp. 1073 *et seq.*

the result of the performance of what we are in the habit of regarding as a physiological function.

The deaths from miscarriage, from shock, from prolonged labor, from instrumental delivery, from convulsions, from hæmorrhage, from rupture of the uterus, and from extra-uterine pregnancy, and deaths from eruptive fevers, from phthisis, and from inflammatory non-puerperal affections complicating childbirth, made a total of 1,395, or about 42 per cent of the entire number. The remaining 1,947 cases, variously reported as puerperal fever, puerperal peritonitis, metro-peritonitis, phlebitis, phlegmasia dolens, pyæmia, and septicæmia, represent the very serious sacrifice of life resulting from inflammatory processes which have their starting-point in the generative apparatus. If we apply the general term puerperal fever to this class of cases, it will be seen that the yearly average of deaths between the years mentioned was 215·5, and that the malady was the cause of nearly one one-hundred-and-twenty-seventh of all the deaths occurring in the city.

More recently statistics have been prepared for me from the same sources by my friend Dr. Rutson Maury for the five years from 1885 to 1889, inclusive, which show that the reported deaths from puerperal sepsis were 1,105, or an annual average of 221.

The population of New York in 1870 was 942,292; in 1875, 1,169,-305; in 1885, 1,553,730; in 1890, 1,755,292. It will be seen, therefore, that the ratio of deaths has by no means kept pace with the increase of the city's population.

A portion of this betterment is doubtless attributable to reforms in the management of our lying-in hospitals. Whereas, formerly these institutions furnished nearly one sixth of the fatal cases of puerperal sepsis, they now, when properly equipped and organized, afford the safest places of refuge for parturient women. There has likewise been, without doubt, an improvement in results among the well-to-do classes. Among these there is a widely diffused belief that puerperal fever is a preventable disease, and that for its occurrence the physician should be held responsible, and this leads to greater painstaking on the part of the latter, even when he is disinclined to accept the deductions from modern scientific teaching. Among the poor, in their own homes, I do not believe that the dangers of childbed have been perceptibly lessened, for in Dr. Maury's statistics it appears that even in the past five years one tenth of the deaths in women between the ages of fifteen and forty-five are due to causes connected with childbirth, and that one twentieth of the deaths among women in the child-bearing period are due to puerperal sepsis.

Max Boehr,* in his now-famous statistics, reckons that one thirtieth of all married women in Prussia die in childbed. The Puerperal

* Untersuchungen über die Häufigkeit des Todes im Wochenbett in Preussen, Zeitschr. f. Geburtsk. und Gynaek, vol. iii, p. 82.

Fever Commission* appointed by the Berlin Society of Obstetrics and Gynæcology arrived at the conclusion that from 10 to 15 per cent of the deaths occurring in women during the period of sexual activity were due to childbed fever, and that this disease destroyed nearly as many lives as small-pox or cholera. But puerperal fever differs from either small-pox or cholera in that the latter presses largely upon the aged and the very young, while the former gathers its victims exclusively from a selected class—viz., from women in adult life, the mothers of families, whose loss, as a rule, is a public as well as a private calamity.

Before proceeding to consider the nature of puerperal fever, it is desirable to first recall the anatomical lesions with which it is associated. These, it will be found, are for the most part inflammatory processes, having their starting-point in injuries of the genital passage produced by parturition, complicated in many cases by septic changes in the blood, by secondary degeneration of parenchymatous organs, and at times by phlegmonous and erysipelatous affections in remote as well as in the adjacent serous and cutaneous tissues.

Morbid Anatomy.—The primary lesions connected with puerperal fever are so various that the student will find it convenient to classify them according as they are situated in the mucous membrane of the utero-vaginal canal, the parenchyma of the uterus, the pelvic cellular tissue, the peritonæum, the lymphatics, or the veins. Not, indeed, that such an arrangement is strictly in accordance with clinical experience—as a rule, the inflammatory processes are rarely limited to a single tissue—but because the prognosis and treatment are determined in great measure by the tissue-system which is predominantly affected. The significance of puerperal inflammations, wherever seated, likewise depends upon whether they are local and circumscribed or whether they present a spreading character.

Personally, I have found the following classification, based on that of Spiegelberg,† of great utility as a means of keeping in mind the principal points to which inquiry should be directed in estimating the significance of the febrile conditions of childbed:

1. Inflammation of the genital mucous membrane.—Endocolpitis, endometritis, and salpingitis.

a. Superficial, suppurative.

b. Ulcerative (diphtheritic).

2. Inflammation of the uterine parenchyma, and of the subserous and pelvic cellular tissue.

a. Exudation circumscribed.

b. Phlegmonous, diffused; with lymphangitis and pyæmia (lymphatic form of peritonitis).

* Zeitschr. f. Geburtsk. und Gynaek, vol. iii, p. 1.

† Ueber das Wesen des Puerperalfiebers, Volkmann's Samml. klin. Vortr., No. 3.

3. Inflammation of the peritonæum covering the uterus and its appendages.—Pelvic peritonitis and diffused peritonitis.

4. Phlebitis uterina and para-uterina, with formation of thrombi, embolism, and pyæmia.

5. Pure septicæmia.—Putrid absorption.

Endocolpitis, Endometritis and Salpingitis.—In the superficial suppurative form of inflammation the mucous membrane of the vagina is swollen and hyperæmic, the papillæ are enlarged, and the discharge is profuse; in the vaginal portion of the cervix the labia uterina are œdematous and covered with granulations which bleed at the slightest touch; in the cavity of the body there are increased transudation of serum and abundant pus-formation. The deep structures of the uterus are usually not affected. Sometimes the inflammation extends to the tubes—*salpingitis*—or, passing outward through the fimbriated extremities, it may spread over the adjacent peritonæum.

The small wounds at the vaginal orifice are at times converted into ulcers with tumefied borders. These so-called puerperal ulcers are covered with a grayish-white layer. They are associated usually with œdematous swelling of the labia. Under favorable sanitary conditions the layer, which consists in the main of pus-cells and necrosed tissue, is thrown off, and the surface heals by granulation. The ulcerative form of inflammation is very rare outside of crowded hospitals.

Diphtheritic ulcers are situated with greatest frequency in the neighborhood of the posterior commissure, or around the vaginal orifice. In rarer instances they are found upon the anterior wall and in the fornix of the vagina, in the cervix, and upon the site of the placenta. The borders are red and jagged; the base is covered with a yellowish-gray, shreddy membrane; the secretion is purulent, alkaline, and fetid; and the adjacent tissues are œdematous. From the vulva they may extend to the perinæum, or pursue a serpiginous course down the thighs. In the uterus and about the cervix they vary as regards size, and are either of a rounded shape or form narrow bands. The intervening portions of tissue which have not undergone destructive changes swell and stand out in strong relief. Where the entire inner surface has become necrosed, it is often covered with a smeary, chocolate-brown mass, which, when washed away with a stream of water, leaves exposed either the deepest layer of the mucous membrane or the underlying muscular structures.

Not infrequently the inflammatory process extends to the tubes, which swell and become tortuous. The tubal canal fills with pus, or in diphtheritic forms, with a fetid, brownish, ichorus material. The distention is most marked at the ampullæ. Usually the fimbriated extremities of the tubes are closed by adhesive inflammation. Sometimes, however, they remain patent, and permit the purulent secretion to spread over the adjacent peritonæum.

Metritis and Parametritis.—In ulcerative endometritis, and even in the extreme suppurative form, the parenchyma of the uterus likewise becomes involved. The changes which are designated under the term metritis consist, in the first place, of œdematous infiltration of the tissues. As a consequence, the organ contracts imperfectly and becomes soft and flabby, so that sometimes, upon *post-mortem* examination, it bears the imprint of the intestines.

In diphtheritic endometritis, the destructive process may attack the muscular tissue, and give rise to losses of muscular substance—a condition known as necrotic endometritis or putrescence of the uterus.

Inflammatory changes are rarely lacking in the intermuscular connective tissue, which exhibits, in places, serous or gelatinous infiltration, with, afterward, pus-formation, and with here and there small abscesses. The sero-purulent infiltration of the connective tissue is specially marked beneath the peritoneal covering of the uterus either behind or along the sides at the attachment of the broad ligaments. In the same situations the lymphatics, which normally are barely perceptible to the naked eye, are sometimes enlarged to the size of a quill, and are characterized by varicose dilatations occurring singly or presenting a beaded arrangement. In the substance of the uterus the dilated vessels are liable to be mistaken for small abscesses. The pus-like substance contained in the lymphatics is composed of pus-cells and of micrococci. From the cellular tissue surrounding the vagina, or that beneath the peritoneal covering of the uterus, the inflammation may spread by contiguity of tissue between the folds of the broad ligament, and thence pass upward to the iliac fossæ. Usually the process is unilateral. After the inflammation has crossed the linea terminalis it may take a forward direction, above the sheath of the ilio-psoas muscle, to Poupart's ligament, or it may creep upward, following the course according to the side affected, of the ascending or descending colon, to the region of the kidney. It is rare for inflammation of the cellular tissue to travel around the bladder to the front. In such cases it pursues its course between the walls of the bladder and the uterus, and along the round ligament to the inguinal canal. In a few cases the cellulitis mounts above Poupart's ligament, between the peritonæum and the abdominal wall.

The course of the inflammation is not simply fortuitous, but follows prearranged pathways in the connective tissue. König* and Schlesinger† have shown that when air, water, or liquefied glue is forced into the cellular tissue between the broad ligaments the injected mass has a tendency to invade the iliac fossæ. In Schlesinger's experiments, if the canula of the syringe was inserted into the anterior

* Arch. der Heilkunde, 3 Jahrg., 1862.

† Gynaekologische Studien, No. 1.

layer of the broad ligament, the glue spread between the folds to the abdominal end of the Fallopian tube; thence, following the track of the vessels, it passed to the linea terminalis; and finally mounted upward along the colon or swept forward to Poupart's ligament, until the advance was stopped at the outer border of the round ligament. If the injection was made to the side of the cervix through the posterior layer at the junction of the cervix and the body, the posterior layer gradually bulged out, the peritonæum was lifted from the side wall of the pelvis, and the glue passed beyond the vessels to reach the iliac fossa. If the injection was made to the side of the cervix through the anterior layer, the glue passed between the bladder and the uterus, and forward along the round ligament to the inguinal canal, while another portion of the fluid passed between the layers of the broad ligament, and reached the peritoneal covering of the side walls behind the round ligament. If the injection was made in the median line, in a peritoneal fold of Douglas's *cul-de-sac*, the fluid traveled forward upon one side along the round ligament, and thence to the posterior wall of the bladder.

The term parametritis, introduced into use by Virchow, is, properly speaking, limited to inflammation of the connective tissue immediately adjacent to the uterus, the older one of pelvic cellulitis furnishing a more comprehensive designation for cases where, as a consequence of a progressive advance from the point of departure in the genital canal, the remoter regions have likewise been invaded. Connective-tissue inflammation presents, as the first essential characteristic, an acute œdema, the fluid which fills the gaps and interspaces consisting of transuded serum rendered opaque by the presence of pus-cells or possessing a gelatinous character. In the mild, uncomplicated cases, the œdema disappears rapidly. Where the cell-collections are of moderate extent, the entire process may vanish without leaving a trace of its existence. If the cell-elements, on the other hand, are present in great abundance, they, as a rule, first undergo fatty degeneration, and, after the absorption of the fluid portion, form a hard tumor composed of a fine granular detritus, which under favorable circumstances likewise, after a few weeks, becomes absorbed. In rare cases, abscess-formation in the tumor results.

In the cellulitis resulting from the more intense forms of septic infection, and especially when complicated by diphtheritis, the tissues seem as if soaked with dirty serum, and contain scattered yellowish deposits, which soon present, even to the naked eye, the appearance of pus-collections. This sero-purulent œdema is always associated with lymphangitis, the lymphatic vessels possessing varicose dilatations and beaded arrangements similar to those already described in the uterine tissue. The foregoing changes are most distinct in the firm connective tissue adjacent to the uterus and at the hilum of the ovary, while they

are less clearly traced in the looser structure of the broad ligament (Spiegelberg).

In favorable cases the inflammation is circumscribed, or at least is limited, by the nearest lymphatic glands. In cases of more severe infection it spreads rapidly, and justifies the title bestowed upon it by Virchow of parametritic malignant erysipelas.

Pelvic and Diffused Peritonitis.—Inflammation of the pelvic peritonæum may proceed from severe attacks of catarrhal endometritis, the inflammatory process either traversing the uterine tissue or passing through the Fallopian tubes to the adjacent serous membrane; in cases of cellulitis it may follow the penetration of pus corpuscles and coccus forms through the lymphatic interspaces and between the endothelia into the peritoneal cavity.

As a rule, pelvic peritonitis is not attended with much exudation. The latter is situated upon the folds of the peritonæum limiting the *cul-de-sac* of Douglas, upon the ovaries, and upon the broad ligaments. In favorable cases it consists of fibrinous flakes and fluid pus. If the latter is abundant, it may become encysted by the formation of adhesions between the pelvic organs.

General peritonitis may result from the extension of a pelvic peritonitis, from the introduction of infectious materials into the abdominal cavity as a consequence of ruptures of the uterus or vagina or of perforation of walls of pus collections, whether contained in the tubes or in the pelvic cavity, or from the transport of poison through the lymphatics into the peritoneal sac. In the first cases, which are characterized by the formation of pus and fibrin, the intestines are distended and the diaphragm is pushed upward. The process begins with capillary injection of the peritonæum, with exudation upon the dependent portions of the abdominal space, and with the appearance of leucocytes about the vessels and in the exudate. This is followed by fibrinous exudation upon the intestines, which unites them loosely together. The endothelial cells of the abdominal sac swell and their nuclei multiply; later, the exudate increases and becomes purulent or watery, but is always mixed with fibrin. The enlarged endothelial cells strip off, the peritoneal and intestinal walls swell and are infiltrated with leucocytes and cells from the division of the connective-tissue corpuscles. By a continuance of this process granulation tissue is produced, which unites adjacent tissues. The watery constituents of the exudation are then absorbed, or pus collections persist, surrounded by pyogenic membranes.

These encysted collections may undergo caseous changes or become ichorous, or may perforate into an intestine, the bladder, the vagina, or through the navel.

In the so-called peritonitis lymphatica the inflammatory symptoms are at the outset lacking. The abdominal cavity is found filled with a thin, stinking, greenish or brownish fluid composed of serum and micrococci.

The intestines are lax and œdematous, and the muscular structures are paralyzed, with the resulting tympanitic distention. The peritoneal covering of the intestines is devoid of luster and covered with injected patches, or is stained of a dark-brown color. Death often ensues before the occurrence of exudation.

Septic forms of pelvic inflammation are often associated with oöphoritis, the dilated lymphatics either extending to the substance of the ovaries, where they may lead to the production of small abscesses, or, as a result of blood dissolution, the organs become soft, pulpy, and infiltrated with discolored serum, and present hæmorrhagic spots distributed over the surface.

Phlebitis and Phlebo-thrombosis.—The formation of thrombi in the uterine and pelvic veins is sufficiently common during the puerperal period. The coagulation may result from compression or from enfeeblement of the circulation. A predisposition to its occurrence is created by relaxation of the uterine tissue. A normal thrombus is in itself harmless. In time it becomes organized, and the occluded vessel is converted into a connective-tissue cord, or a channel may form through it which permits the passage of the blood-stream. When, however, septic microbes obtain access to a thrombus, it undergoes rapid disintegration, and the particles get swept away into the circulation until arrested in the ramifications of the pulmonary artery. Wherever these poisoned emboli happen to lodge, inflammation is set up in the adjacent tissues, and abcesses result (pyæmia multiplex). Sometimes countless collections of pus may form in the lungs. Less commonly abscesses are found in the liver or spleen, originating either from emboli which have already made the pulmonary circuit, or from thrombi in the pulmonary veins.

Inflammation of the veins (phlebitis) sometimes occurs when the vessels have to traverse tissues in or near the uterus infiltrated with purulent or septic materials. The endothelium then undergoes proliferation, and thrombosis is produced. Phlebitic thrombi do not necessarily break down, and may in that case act as a barrier to the progression of septic germs into the circulation (Spiegelberg). As a rule, however, under the influence of inflammation and infection, they become converted into puriform masses.

The thrombi grow by accretion in the direction of the heart. They may extend from the uterus through the internal spermatic, or through the hypogastric and common iliac veins, to the vena cava. Sometimes the thrombus may be traced back to the placental site.

Septicæmia.—From these local conditions, sooner or later, secondary affections develop in distant organs. The general affection is, in great part at least, likewise of local origin. Sometimes, however, where the poison, which enters the system through the lymphatics and veins, is very active and abundant, death may follow from acute septicæmia

before the changes in the sexual organs have had time to develop. The fatal result, in these cases, is probably due to paralysis of the heart. After death, *post-mortem* decomposition rapidly sets in, the blood is sticky, and swelling is found in the various parenchymatous organs.

The secondary affections consist in the metastatic abscesses already noticed as produced by infected emboli, in circumscribed purulent collections due to the conveyance of septic materials into the blood-current through the lymphatics, in ulcerative endocarditis, in inflammations of the pleura, the pericardium, and the meninges, and in purulent inflammation of the joints.

Sapræmia (Putrid intoxication).—This term was invented by Matthews Duncan to apply to the fever which results from the absorption into the blood of sepsin and the ptomaines, the products of putrefaction, in distinction from the febrile forms due to the entry into the circulation of bacteria capable of reproduction. In sapræmia the fever and general symptoms rapidly disappear when the source of poison supply, usually the uterine cavity, has been washed clean and thoroughly disinfected.

A study of the nature of puerperal fever will best show how intimately these seemingly distinct processes are linked together.

Earlier Views concerning the Nature of Puerperal Fever.*—According to the teachings of Hippocrates, Galen, and Avicenna, of Ambrose Paré, of Sydenham, and of Smellie, the fevers of puerperal women were attributable to the suppression of the lochia. For twenty centuries this doctrine was accepted almost without dispute, the best clinical observers confounding a symptom which is often lacking with the cause of the disease itself.

In 1686, Puzos † taught that milk, circulating in the blood, is attracted to the uterus during pregnancy and to the breasts after confinement, but that milk metastases may form in other parts, and produce the symptoms of malignant or intermittent fever. In 1746 A. de Jussieu, Col de Villars, and Fontaine advanced in support of this theory the fact that they had found, on opening the abdomen in women who had died from an epidemic which raged that year in Paris, a free lactescent fluid in the lower portion of the abdominal cavity and clotted milk adherent to the intestines. This doctrine, which seemed to be based upon, and to accord with observation, found many adherents in France. It lost ground, however, when, in 1801, Bichat pointed out the true nature of the abdominal effusions of women who had died in childbed, and demonstrated that they were to be found likewise in peritoneal inflammations occurring in men and in non-puerperal women.

* For data given, and for a great variety of historical information, *vide* Hervieux. Traité clinique et pratique des maladies puerpérales.

† Premier mémoire sur les dépôts lacteux.

While, during the second half of the eighteenth century, the doctrine of milk metastasis held full sway in France, in England and Germany the dominant leaders in medicine referred the causes of puerperal fevers to inflammations of the womb and of the peritonæum. With the advances made in pathological anatomy in the beginning of the present century, France taking the lead, stress was likewise laid upon inflammations of the veins and of the lymphatics. The vitality of the doctrine of local inflammations is well shown by the records kept by the Health Board of this city, where a large proportion of the deaths returned from childbed fever are entered under the head of metritis, of peritonitis, of metro-peritonitis, and of puerperal phlebitis.

In opposition to the doctrines of the so-called localists, the theory that puerperal fever is an essential fever, and as much a distinct disease as typhus fever, typhoid fever, or relapsing fever, has been strenuously advocated by some of the most distinguished clinical teachers who have devoted their attention to obstetrical science.

Fordyce Barker, in his classical work upon the Puerperal Diseases, states the arguments against the local origin of the diseases as follows: 1st, that puerperal fever has no characteristic lesions; 2d, that the lesions which do exist are often not sufficient to influence the progress of the disease or to explain the cause of death; 3d, that there may be inflammation, even to an intense degree, of any of the organs in which the principal lesions of puerperal fever are found, and yet the disease will lack some of the essential characteristics of puerperal fever; 4th, that the lesions are essentially different from spontaneous or idiopathic inflammations of the tissues where these lesions are found; 5th, that puerperal fever is often communicable from one patient to another through the medium of a third party, and that this is not the fact in regard to simple inflammations in puerperal women.

However, neither Barker nor those who entertain views similar to his question the local origin of many febrile affections in childbed, but claim that purely local inflammations have each their characteristic symptoms, which differ from those of true puerperal fever; that puerperal fever is a zymotic disease of unknown origin; and that local lesions, where they coexist, are not the primary source of trouble, but are secondary to changes in the blood.

In 1850 James Y. Simpson* published a short paper On the Analogy between Puerperal and Surgical Fever. This article may well be regarded as the foundation of the modern doctrine concerning puerperal fever, and is well worthy of perusal at the present day; for, though in the then existing state of pathology many of the links were wanting which have since raised the argument to nearly a mathematical demonstration, the paper furnishes a brilliant example of the

* Edinburgh Medical Journal.

scientific foresight which is able to discern the truth even where the evidence lacks completeness.

In 1847 Semmelweis, who was at that time clinical assistant to the Lying-in Hospital at Vienna, made the startling assertion that "puerperal patients were chiefly attacked with puerperal fever when they had been examined by the physicians who were fresh from contact with the poisons engendered by cadaveric decay; that fever ensued in the practice of those who, after *post-mortem* examination, washed their hands in the usual manner, whereas no fever or but few cases of disease followed when the examiner had previously washed his hands in a solution of chloride of lime." In the face of insult, ridicule, and abuse Semmelweis maintained this position for years, almost unaided, with fanatical persistency. It was easy for his opponents, for the most part managers of the great lying-in asylums, to show from clinical experiences the weakness of so one-sided a theory. But the employment of the equivocal demonstration *falsus in uno, falsus in omnibus*, served only as a temporary defense against the laxity which prevailed in hospital management only a quarter of a century ago. Though Semmelweis died with no other reward than the scorn of his contemporaries, it is impossible at the present day to so much as contemplate the abuses he attacked without a shudder.

In 1860 Semmelweis published the result of his ripened experience in a treatise entitled Die Aetiologie, der Begriff und die Prophylaxis des Kindbett-fiebers, in which, abandoning his earlier exclusive position, he maintained that puerperal fever arises from the absorption of putrid animal substances, which produce first alterations in the blood, and secondly exudations. He distinguished between cases in which the infection was introduced from some external source, and which he believed to be the most frequent variety, and those where the poison was generated in the system. The sources from which the infection is derived he believed to be—1st, from the dead body, regardless of age, sex, or disease, no matter whether the latter is of puerperal or non-puerperal origin, the virulence depending upon the stage of decomposition; 2d, diseased persons, whose malady is associated with decomposition of animal tissue, no matter whether the affected person suffers from childbed fever or not, the decomposing matter alone furnishing the product from which infection is derived; 3d, physiological animal substances in the process of decomposition. As carriers of infection, he regarded the fingers and hands of the physician, midwife, or nurse, sponges, instruments, soiled clothing, the atmosphere, and, in brief, anything which, after being defiled with decomposing animal matter, was brought into contact with the genitals of a woman during or subsequent to parturition. Absorption takes place from the inner surface of the uterus or from traumata in the genital canal. Infection seldom occurs in pregnancy, because of the closure of the os internum,

the absence of wounded surfaces, and because of the rarity with which examinations are made; during dilatation infection is common, but exceptional during the period of expulsion, because the inner uterine surface is at that time rendered inaccessible by the advance of the child; in the placental and puerperal period infection occurs from utensils and instruments, but chiefly through the access of atmospheric air when the latter is loaded with decomposing organic matter. In rare instances, auto-infection may result from spontaneous decomposition of the lochia, of bits of decidua, of coagula of blood, of necrosed tissue, or in consequence of severe instrumental labors. In a word, puerperal fever was, according to Semmelweis, no new specific disease, but a variety of pyæmia.

The Nature of Puerperal Fever as regarded from the Standpoint of Modern Investigation.—The older beliefs in the suppression of the lochia and the metastases of milk have long since been relegated to the domain of old nurses' lore, and do not call for serious discussion. The localist theory, that puerperal fever is a metritis, a peritonitis, a phlebitis, or an inflammation of the lymphatics, is, as mortuary records show, still adhered to by many practitioners, and, as we have seen, is justified by the fact that puerperal fever is, with rare exceptions, associated, at some period of its progress, with certain inflammatory processes which have their starting-point in the generative apparatus. But the localist theory leaves out of view the existence of blood-poisoning, and yet the coexistence of a blood-poison with the local lesions is an essential feature of puerperal fever. It was this defect which gave to the advocates of the specificity of puerperal fever their real importance. Modern investigation has, however, proved that the puerperal poison is septic in character, and that puerperal fever is really a surgical fever, modified, however, by the peculiar physiological conditions which belong to the puerperal state.

Thus, it has been found that, in the human subject, and in experiments made upon animals, septic poisons introduced into the system following or near delivery produce lesions similar to those found in puerperal fever. As a further coincidence, it has been noticed that, as in puerperal fever, the lesions from direct septic poisoning have nothing characteristic about them, producing in one case pyæmia, in another partial peritonitis, in another general peritonitis, in another diphtheritis, while in others the lesions are comparatively trivial, these differences being due to variable facta, such as the qualities of the septic poisons, the points of entry into the organism, and the resistance offered by the invaded tissues.

There is one experimental point of extreme practical importance in connection with puerperal septicæmia—viz., that if the injection of a septic fluid be made directly into a vessel, toxic effects speedily follow, but are transitory, unless the amount of the fluid be large, or its viru-

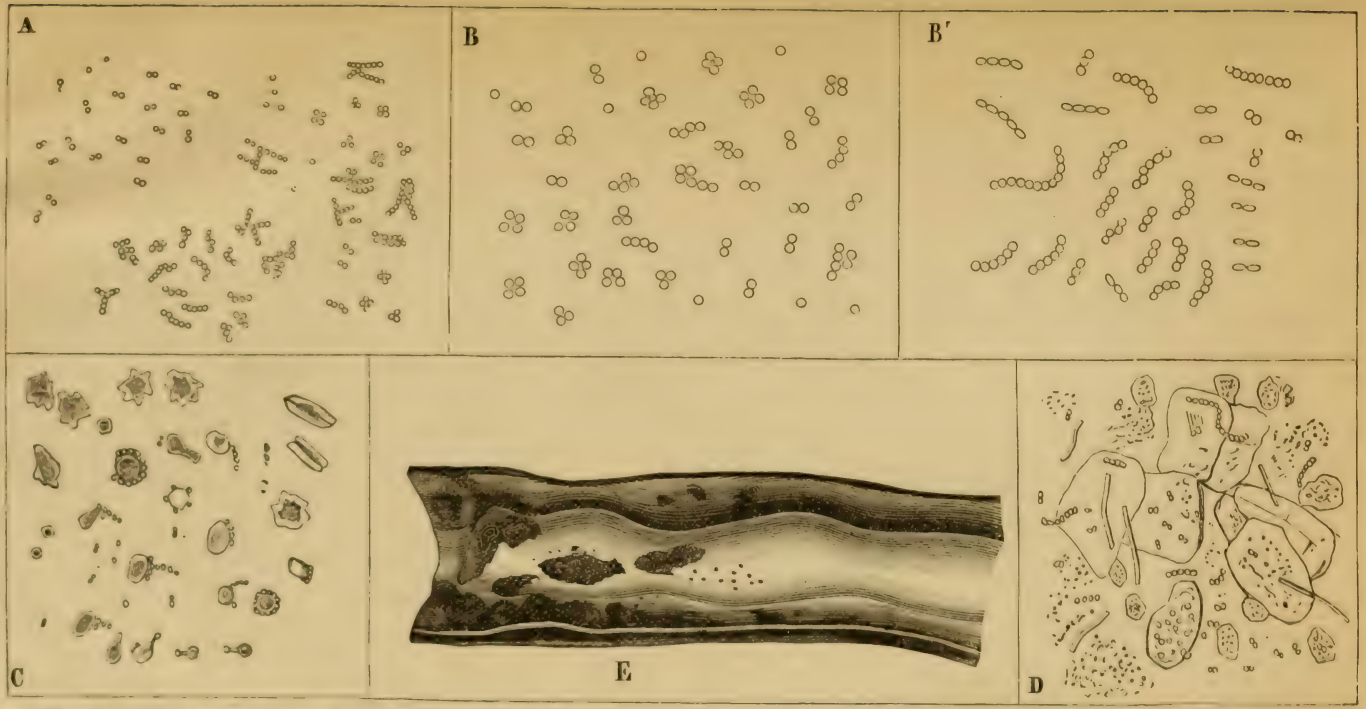


Fig. 232.—Specimens of micrococci. A, specimens from pus and blood presenting simple points (monococci), double points (diplococci), and beaded forms. B, micrococci of large size from patient dying of lymphangitis and peritonitis. B′, the same seventy hours later. In both the foregoing the micrococci have been isolated, and have been cultivated in independent fluids. C, Shrunken, misshapen appearance of the blood-corpuscles produced by micrococci. D, appearance of micrococci in the lochia. E, clot in a crural vein. The dark points are colonies of micrococci beneath the endothelium. (Doléris.)

lence exceptional, or the animal very young; whereas very small amounts injected subcutaneously, by developing rapidly spreading phlegmonous inflammation, resembling malignant erysipelas in man, are capable, after a period of incubation, of producing fatal results; or they may, if injected into a shut cavity or underneath a fascia, lead to the development of an inflammation of an ichorous character. In other words, the eliminating organs suffice, under ordinary conditions to remove from the blood an amount of septic fluid which would prove fatal if injected into the tissues. To produce similar results the injections into the blood need to be repeated at intervals. This experience leads us to the conclusion that, in the tissues, septic poisons possess the capacity of self-multiplication, and that from the local inflammation set up a supply is formed from which poisonous matter is continuously poured into the circulation.

The capacity of self-multiplication with which septic materials are endowed has been found to be the property of certain parasitic bodies termed bacteria. The prevailing pathogenic organisms in puerperal-fever cases, according to the researches of Doléris, consist of bacilli or rods, and of micrococci in the varieties of monococci or single points; of diplococci, double points; and of streptococci or chain and wreaths. Staphylococci are sometimes found in parametritic abscesses, or even in the uterine cavity. It is conceded, however, that the streptococci are the important factors in the production of infection.

Without entering upon difficult and unsettled questions concerning the manner in which disease germs accomplish their destructive work during the puerperal period, it may be stated that, in the first place, they generate, as one of their vital functions, toxic substances which kill the tissues, excite inflammations, produce fever, and give rise to nervous disorders.

The bacilli are the agents of putrefaction. Their action is local. They attack dead tissue only (clots, bits of placenta, shreds of membrane, portions of decidua). They do not themselves invade the tissues. The products of putrefaction contain certain poisons termed ptomaines, which when they enter the circulation, cause a general intoxication. When the offending substances are removed from the uterine cavity, the systemic symptoms disappear.

The instinct which prompts the employment of the disinfectant douche in cases where there is a stinking lochial discharge is a sound one, but it is a common clinical observation that in many cases the symptoms continue thereafter unabated, and that, likewise, in severe and even in fatal forms of puerperal fever the lochia are free from odor.

True infective puerperal fever has no direct connection with putrefactive organisms. It is the product of the streptococci, which not only are in themselves highly poisonous, but possess the faculty of

Fig 1.

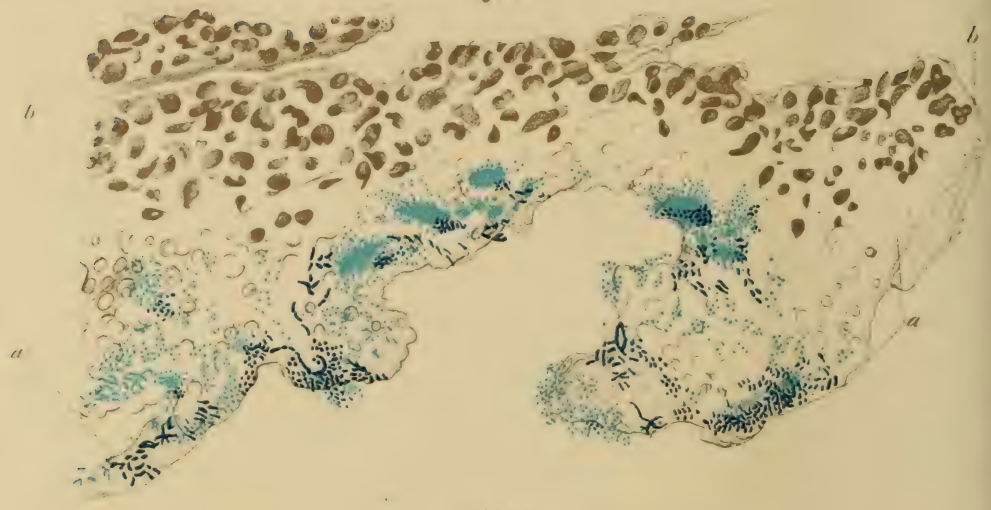


Fig. 2.

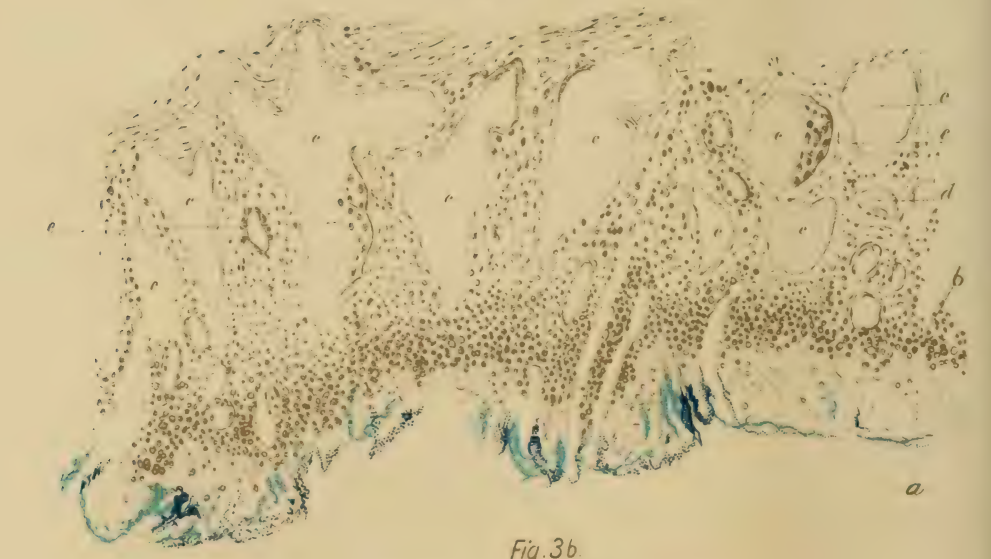


Fig. 3b

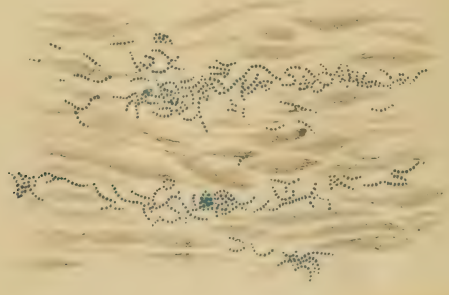


Fig. 3 a.

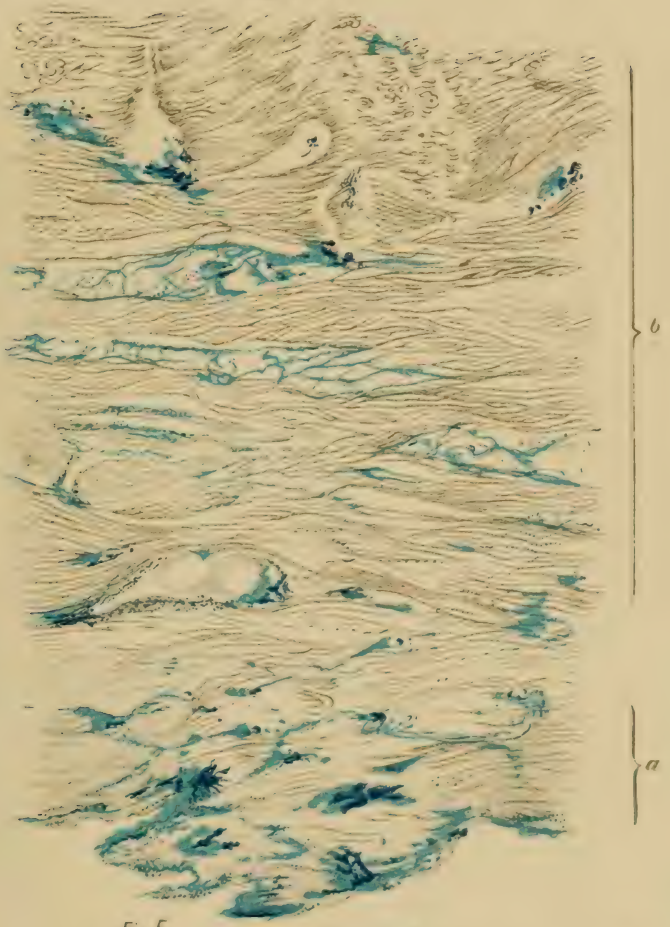
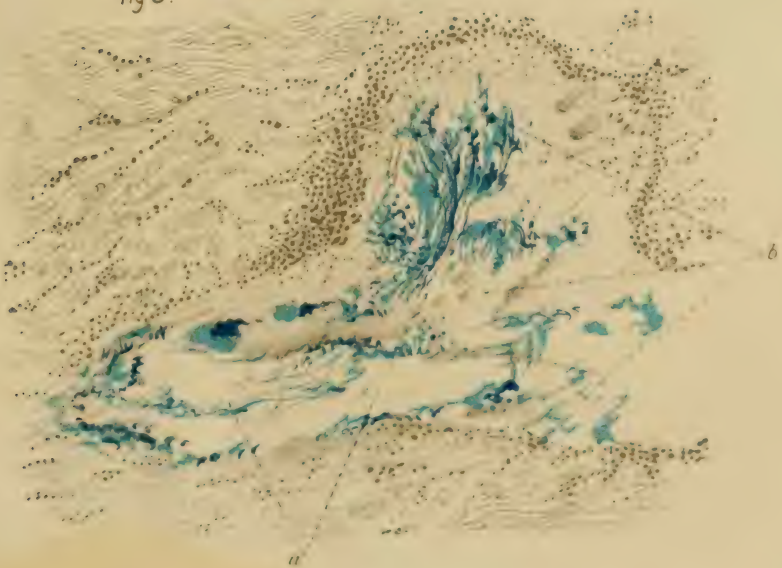


Fig 5.



invading living tissue. But the putrefactive and the infective germs are generally present together. It is surmised that when they are thus associated, the putrid endometritis excited by the one furnishes a congenial soil which favors the multiplication of the other.

DESCRIPTION OF PLATE IV.

MICROSCOPIC SECTIONS IN PUERPERAL ENDOMETRITIS. (BUMM.)

FIG. 1.—Section through decidua removed by curette in case of putrid endometritis (ninth day of childbed). *a*, necrosed layer of decidua infiltrated with putrefactive germs; *b*, reaction layer, showing nuclei of the leucocytes.

FIG. 2.—Section through decidua in case of septic endometritis (seventh day of childbed). Plate cultures furnished streptococci pyogenes, staphylococci aurei, and several saphrophytes. *a*, necrosed layer of decidua; *b*, reaction zone; *c*, gland lumina; *d*, section through vessels; *e*, remains of glandular epithelium.

FIG. 3*a*.—Section through decidua and adjacent muscular walls from a puerperal woman who died of acute sepsis, with septic peritonitis, on the fourth day of childbed. *a*, necrotic decidua; *b*, muscular tissue.

FIG. 3*b*.—Portion of Fig. 3*a* more highly magnified. Streptococci growing between the muscular fibers, as in erysipelas.

FIG. 5.—Section of uterine wall in lymphatic peritonitis (death on twelfth day). *a*, lymph vessel filled with streptococci; *b*, eruption of the fungi into the adjacent muscular tissue, which has become necrosed. Arborescent distribution.

Rarely the streptococci pass from the uterine cavity by the Fallopian tubes to the peritoneal sac. This probably only happens when the tubes have been rendered patent by antecedent disease. In many instances the action of the streptococci is confined to the inner surface of the uterus. In these cases and in those of ordinary putrid endometritis a layer of leucocytes forms next to the necrosed tissues which acts as a wall to prevent the penetration of the germs into deeper-lying structures. In the event of general infection, this barrier has been feebly developed, and was easily broken through by the invading host.

In the lymphatic form of septicæmia the streptococci pass, sometimes, through the narrow gaps between the muscular fibers to the peritoneal surface of the uterus, or, more frequently, they enter the canalicular spaces in the connective tissue forming the framework of the genital canal which is continuous with subperitoneal connective tissue of the pelvis. From the canalicular spaces they enter the lymphatics. Cellulitis is excited by their presence, and the lymphatic glands become inflamed and enlarged. In the walls of the uterus the lymphatics are, in places, found distended with cocci, which excite inflammatory processes in the neighborhood followed by necrosis of the muscular structures, by migration into the softened tissue of masses of leucocytes, and by the formation of small sequestered abscesses (Bumm).*

In pernicious forms they produce a sero-purulent œdema, which spreads rapidly with a wave-like progress after the manner of erysipelas; or, in milder cases, the progress of the disease germs is arrested by

* BUMM, Histologische Untersuchungen ueber die puerperale Endometritis. Arch. f. Gynæk. Bd. xl, pp. 398 *et. seq.*

the lymphatic glands or the resistance offered by the tissues themselves, and the ordinary circumscribed phlegmon is produced. By the lymphatics which accompany the vessels of the Fallopian tubes they reach the ovaries (puerperal ovaritis), and by the broad ligaments they pass to subperitoneal tissues of the iliac and lumbar regions. Through the same system they are conveyed to the great serous cavities of the body. In the peritonæum they give rise, unless death occurs too speedily, to pyæmic peritonitis, which, unlike the traumatic form, is attended with but little pain. The wide stomata upon the abdominal surface of the diaphragm allow the facile entrance of the organisms into its lymphatics. Waldeyer found, in diaphragmitis, the lymphatics of the diaphragm filled with bacteria. And thus, following the lymphatic system, the frequency, in severe types of puerperal fever, of inflammation of the serous membranes of the peritonæum, the pluræ, the pericardium, the meninges, and the joints finds an easy explanation. Nor is it altogether accident which determines in different cases the precise serous membranes which are affected. The widespread ramifications of the lymphatic system would naturally give rise to eccentric inflammations in place of those following the apparent continuity of tissues.

When the streptococci infect wounds about the vulva and in the vagina the resulting process is apt to be local unless the germs possess an unusual degree of virulence. As regards their effect upon wounds of the cervix, the question is still open to debate, but here, too, it is probable that the tendency is to the formation of circumscribed inflammations.

The streptococci are detected with difficulty in the blood during life. A few hours after death they swarm in that fluid. That they do, however, enter the general circulation during life is incontestable. Steurer writes: "As the kidneys are the great filters of the human system, I never neglected to examine them, and almost invariably found micrococci filling the arterioles and glomeruli." This is in correspondence with what occurs in other septic diseases, and accounts for the albuminuria and interstitial nephritis which often supervene in the advanced stages. They are likewise found in the liver and in the spleen. Doléris assures us that in puerperal fever, by repeated trial, especially after a chill, he has never failed to demonstrate their presence in the circulation. They do not, however, multiply in the blood during life. When they come in contact with the red corpuscles, the corpuscles stick together and form larger or smaller clots in the blood. They then are no longer able to pass through the minute capillary networks, but are arrested in the vessels (Koch). The micrococci in the resulting infarctions multiply and migrate into the vessels and cellular tissue of the neighborhood. Thus fresh foci of infection are formed. Or, by their destructive action they may, when situated near the serous surfaces, penetrate into the serous cavities, and in this way indirectly occasion

peritonitis, pleurisy, meningitis, and purulent inflammations of the joints. When the micrococci enter directly into the circulation they sometimes, in passing through the heart, adhere to the endocardium and the valves, where they cause exudation and ulceration, and give rise to the so-called endocarditis ulcerosa puerperalis. The red globules of the blood undergo changes of shape, assume a stellate aspect, and rapidly disappear. The white globules are greatly increased in numbers, and the blood itself becomes nearly colorless. A certain amount of light is thrown upon these blood changes by Doléris, who added micrococci to the fresh blood of a frog and watched the ensuing changes under the microscope. The micrococci could be seen in the act of penetrating the red globules, which thereupon lost their color and became shrunken, and, following the discharge of the organisms, which meantime had multiplied in an astonishing manner, little or nothing of the original globules remained.

The thrombotic form of infection has been studied by Bumm in the veins which spring from the placental site. He found that the migratory movements of the cocci from the endometrium followed the axis of the thrombus, and thence spread outward toward the vein walls. The latter then became infiltrated with round cells, which quickly made their way into the canal of the vessel. A disintegration of the clot was associated with these occurrences, and thus the vessel became filled with a detritus composed of leucocytes, of parasitic organisms, and of the *débris* of the thrombus. In other instances, according to Doléris, micrococci derived from the blood are deposited upon the central extremities of the clots; beyond these dépôts a fresh inflammation is set up, followed by fibrinous coagulation. Thus the micrococci become imprisoned between two plugs. The same process may be repeated until a series of abscesses is formed. For a time no mischief may ensue. Finally, however, the resistance of the outworks is overcome, an embolus becomes detached, and an infectious abscess is opened into the blood —an event which is announced by an intense chill and the familiar systemic derangement.

In septic diseases death takes place from apnœa, partly from the inability of the blood-corpuscles to carry oxygen to the tissues—and partly from paralysis of the nerve centers.

In estimating the susceptibility to sepsis in the puerperal state it is necessary to take into account the blood changes induced by pregnancy, the effects of shock and exhaustion in protracted labors, the frequency of hæmorrhage, the deep situation of puerperal wounds, the presence of clots, decidua, and dead tissue in a state of disintegration or decomposition, the ease with which deleterious matters are absorbed by the wide lymphatic interspaces, the serous infiltration of the pelvic tissues, the exaggerated size of the lymphatics and veins, and the proximity of the peritoneal cavity.

Samuel,* in speaking of the immunities and dispositions to septic poisoning, says: "The statistical frequency of septic puerperal disease is due to the length of the parturient canal, to the fact that through this long passage there must pass all the pathological and physiological excretions, and to the soiling of these parts with fingers, instruments, and secretions which have become the bearers of sepsis." He found, on the other hand, that it was extremely difficult to produce a progressive ichorous condition by daily painting an open stump with a septic fluid,† though the same was readily obtained when an infinitesimal quantity of septic fluid was injected underneath a fascia.

We have seen that when septic organisms are introduced into the uterine cavity there are individual differences in the ensuing results. Thus, in many cases, their action is limited to the production of local inflammatory troubles and to self-limited systemic disturbances, while in others they overcome all resistance and lead to the most far-reaching changes in the blood, in the circulatory apparatus, in the parenchymatous organs, and in the serous cavities. The reason for these differences are to a certain extent a matter of conjecture. It is, however, admitted that the virulence of disease germs may be modified by culture experiments, or by seemingly accidental conditions. Bumm maintains that what is termed virulence is an acquired power of bacteria to withstand the destructive influences upon them of the saps and tissues, and to multiply within the living body. That the innate powers of resistance to morbific agencies differs in individuals seems probable. Kehrer reminds us that, before the antiseptic period, it was not uncommon for a practitioner fresh from an autopsy upon a puerperal woman who had died of lymphatic peritonitis, to examine patients in labor with hands which had been simply washed in soap and water, and that of the women thus infected a certain number had violent or even fatal forms of sepsis, while others were scarcely perceptibly affected. Doubtless, when the uterus is firmly contracted, the clots in the orifices of the placental veins are small, and the invasion of cocci is hindered by the compression of the lymphatic spaces, and *vice versa*. With a flabby, relaxed uterus, the soft thrombi and the widely dilated absorbents furnish favorable conditions for the spreading of infection.

While insisting upon the septic character of puerperal fever and its association with the presence of streptococci, it is not pretended that inflammations of the pelvic organs in childbed may not proceed from other causes. Indeed, I have myself witnessed cases where peritonitis has seemingly started from old intraperitoneal adhesions, or was secondary to ulcerative processes in the cœcum or the descending colon. I am inclined, likewise, to agree with Genzmer and Volk-

* Ueber die Wirkung des Fäulniss-Processes auf den lebenden Organismus, Arch. f. exp. Pathologie. vol. i, p. 343.

† *Loc. cit.*, p. 339.

mann * that there is such a thing as an aseptic surgical fever due to the absorption of the products of physiological tissue-changes at the seat of injury. In surgical cases, even where the precautions of Listerism have been faultlessly observed, febrile movements of considerable intensity, but of no prognostic signification, are of frequent occurrence. While, in puerperal women, we can never exclude the possibility of the septic infection of puerperal wounds, it is in accordance with clinical experience to assume that a high fever belonging to the aseptic class may coincide with a septic process of insignificant proportions.

General Symptoms.—As in other infectious diseases, there is, from the time of the entry of the poison into the system up to the outbreak of fever, a distinct period of incubation. The first febrile symptoms usually occur within three days of the birth of the child. An attack coming on a few hours after childbirth is indicative of infection during or previous to labor. The third day is the one upon which, ordinarily, the beginning of the fever is to be anticipated. After the fifth day an attack is rare, and at the end of a week patients may be regarded as having reached the point of safety. Apparent exceptions to this rule are probably referable to cases of mild parametritis, in which the initial fever and the pain were insufficient to attract attention to the existence of local inflammation.

The symptoms of puerperal fever vary with the character of the local affections, and with the extent to which the general system participates in the disturbed action. The different groups of puerperal processes possess the following pathognomic symptoms—viz., increased temperature, enlargement of the spleen, disturbed involution, and sensitiveness of the uterus upon pressure (Braun).

In most cases, the fever is ushered in by chilly sensations or by a well-defined chill. This symptom, however, does not possess much prognostic importance. A chill is significant of a sudden change between the temperature of the skin and that of the surrounding medium. It may, therefore, be absent in pernicious forms of fever, provided only that the temperature changes are inaugurated slowly, whereas it may follow a trifling increase of the body heat if, as sometimes happens in sleep, the moist skin is exposed to cool currents of air. Repeated chills indicate phlebitis and pyæmia.

In order to grasp the many symptoms of puerperal fever it is necessary to keep separately in mind the clinical features of each of the local processes, although in fact the latter rarely occur singly, but to a greater or less extent in combination with others.

The Symptoms of Endometritis and Endocolpitis.—The uncomplicated catarrhal inflammation of the uterus and vagina is the most frequent and the mildest of the diseases of childbed. In endometritis the

* Genzmer and Volkmann, Ueber septisches und aseptisches Wundfieber, Samml. klin. Vorträge, No. 121.

uterus is large, flabby, and sensitive upon pressure; the after-pains are often unusually severe, involution is retarded, and the lochia become fetid, remain sanguinolent for a longer period than usual, and at the outset may be temporarily suspended. Sometimes the large intestine is distended with flatus. In endocolpitis the vaginal discharge is thin and purulent, the patient experiences pain and burning in the acts of defecation and urination, and, where the wounds of the vulva and vagina assume an ulcerative character, there is often found at the same time inflammatory œdema of the labia.

The fever in these cases is ushered in frequently, but not always, by chilly feelings, and the temperature reaches its height usually upon the evening of the third or fourth day, is remittent, almost intermittent in character, and rarely exceeds 102° to 103° Fahr. In mild forms the occurrence of the fever is often overlooked, or is referred to disturbance produced by the secretion of the milk. In severer attacks the febrile symptoms may continue from three to seven days. At the end of a week the swelling of the labia subsides, the discharge becomes thick, and ulcers, if present, begin to assume a healthy granulating appearance.

In diphtheritic ulcerations, and in endometritis due to decomposing remains of the ovum, the local condition is often complicated by the invasion of the neighboring tissues.

The Symptoms of Parametritis and Perimetritis (Pelvic peritonitis *).—The symptoms of these two affections, as would be naturally expected from the proximity of the peritonæum to the pelvic connective tissue, for the most part overlap. It must be very rare for one form to occur entirely independent of the other. For this reason it will be found convenient to consider first the symptoms common to both morbid processes, and subsequently to direct attention to what are believed to be points of distinction between them.

During the period of incubation there are usually no prodromic symptoms Elevations of temperature in the course of the first twelve hours following labor are equally frequent under perfectly normal conditions. Suspicious symptoms are disturbed sleep, excessively painful after-pains, and a pulse of 80 to 90.

The beginning of the fever occurs, in 90 per cent, within the first four days of childbed; most frequently upon the second or third day, and taking place upon the fourth day in scarcely 12 to 15 per cent of the cases. If five days have elapsed without fever, the period of danger, with very rare exceptions, may be regarded as having passed.

At the outset the fever, especially in perimetritis, is ushered in by

* The following clinical history, together with the statistical details, is borrowed in great part from the description of Olshausen (Ueber puerperale Parametritis und Perimetritis, Volkmann's Samml. klin. Vortr., No. 28), the exactitude of which I have had abundant opportunity to verify.

chilly sensations or by an intense chill. The temperature rises rapidly, though the highest point is usually not reached before the second, and in rare cases not before the third day. In most cases, the heat in the axilla exceeds 103°, and may even mount up to 105°. The decline occurs gradually, the fever ending in 70 per cent in the course of a week, in 20 per cent in two weeks, and only in 10 per cent extending beyond that period. Protracted cases indicate abscess formation.

The fever does not, however, always pursue a regular course. In place of progressively declining until the termination is reached, the high temperature of the second day may be attained upon one or more occasions. The morning remissions are at first slight, but become marked as the disease approaches its close. In cases of long duration the morning hours are often free from fever, a circumstance calculated to mislead a physician who sees his patient but once a day. A pulse of 80 to 90 beats, a disturbed sleep, lack of appetite, and sensitiveness to pressure upon the sides of the uterus are, however, symptoms which should serve as a warning of some disturbing cause, and should lead the physician to renew his visit in the latter part of the day.

If, from a mistaken notion that the morbid process has come to an end, the patient is allowed prematurely to resume her household duties, the pains across the abdomen and along the hip and thigh return, and an examination reveals the existence of exudation in the pelvic cavity or upon an iliac fossa.

Errors of this kind are most frequent in cases of parametritis associated with slight peritoneal inflammation, as the local pain is then insignificant, and the initial chill, happening on the third or fourth day, is apt to be ascribed to engorgement of the breasts.

Relapses after the complete disappearance of febrile disturbance occur in 15 to 20 per cent. They are usually shorter, but sometimes more obstinate, than the original attack. As a rare exception may be mentioned cases with evening remissions and morning exacerbations.

In circumscribed pelvic inflammations the pulse rarely exceeds 120 beats to the minute. A pulse of 140, of more than half a day's duration, betokens severe septic complications, and is therefore of evil omen. In some cases the slow pulse observed after labor makes its influence felt in the first day or two of the fever, so that the curious phenomenon may be witnessed of a temperature of 104° coinciding, for a time, with a pulse ranging between 50 and 70 beats to the minute.

As regards other symptoms, headache and sleeplessness are rarely absent. Profuse sweating follows the first febrile attack, and frequently recurs during the course of the disease.

Pain is present at the onset in the majority of cases, and is then usually most violent. The spontaneous pain, which is due to the affection of the peritonæum, subsides in great part in the course of one or two days, but the sides of the uterus remain sensitive to pressure.

In the rare cases of pure parametritis, however, this symptom may be absent altogether. The pain, like that from the inflammation of serous membranes, is of a lancinating character. Sometimes it is associated only with the contractions of the uterus. After-pains occurring under unusual circumstances, as in primiparæ or after the third day, are to be regarded with suspicion.

Vomiting occurs occasionally, but is comparatively rare, unless the peritonitis becomes diffused and spreads to the region of the stomach. The appetite is lost, and only returns, as a rule, with the departure of the fever. The tongue is coated and moist, and constipation is common. In other cases there is diarrhœa, with rumbling in the bowels, but without pain or tenesmus. The urinary secretion is rarely interfered with, and, when this is the case, it indicates the extension of the inflammation to the peritonæum covering the bladder.

Most cases of perimetritis and parametritis terminate in five or ten days, the fever and other symptoms gradually subsiding. When, as may happen in exceptional instances, the temperature falls suddenly from a high degree to one below the normal level, the body grows icy cold, the pulse becomes small and irregular, and symptoms of collapse develop. But, in twelve to twenty-four hours, the symptoms of collapse subside, and the disease reaches its end with a disappearance of the alarming manifestations.

If the fever subsides within a week, exudation is somewhat rare. Its continuance beyond that date should lead to a careful exploration of the pelvic organs. The exudation is usually demonstrable in the course of the second week or at the beginning of the third week. It is recognized, according to its location, by external or by internal examination, or, where the deposit is considerable, by both methods. In many cases the deposit is extra-peritoneal, and is situated between the folds of the broad ligament, above and to the sides of the vaginal *cul-de-sac*. It has generally a rounded form, though with less convexity than fibrous and ovarian tumors. Sometimes, however, the tumor is flat below, like a board. It seldom exceeds in size that of a large apple. In fresh exudations the sensation produced is often that of a hard tumor surrounded by a softer layer, due to continued succulence of the soft parts. In a few weeks they may reach or exceed the hardness of a fibroid tumor. The older the tumor, unless suppuration sets in, the less sensitive it becomes. Often the exudation extends to the pelvic walls. The uterus, as a rule, is fixed, and, in cases of large tumors, becomes pushed toward the opposite side, while, as a consequence of later shrinkage, the fundus may be drawn permanently toward the affected side.

The *cul-de-sac* of the vagina is rendered broader and flatter by the pressure of the deposit, or, when the tumor is deep enough, the vaginal surface may be rendered convex. Behind the uterus the exudation

is, as it were, flattened antero-posteriorly, and in some cases it may be felt in the form of rigid bands between the posterior ligaments which inclose the *cul-de-sac* of Douglas. The ante-uterine tumors have a spherical shape and depress the vagina anteriorly.

Tumors situated in the iliac fossa have a more or less convex form, and may be of such considerable size that the swelling may be recognized by the eye through the abdominal walls. As the exudation between the broad ligaments may, in these cases, have been slight from the beginning, or may have subsequently disappeared by absorption, the iliac tumors have often, apparently, a spontaneous origin.

Sometimes the uterus is surrounded by exudation, and the entire pelvis appears as though it were a mold filled with a solid mass. The fornix is then often pressed downward, and irregular rounded masses are to be felt through the vaginal walls.

The recognition of parametritic tumors through the abdominal coverings is possible when they are situated above Poupart's ligament, in the upper portion of the broad ligaments, and in the iliac fossæ.

Unquestionably many supposed parametritic tumors have been really cases of salpingitis with accompanying intraperitoneal deposit of lymph.

The pain and the functional disturbances in the pelvic organs depend upon the size and situation of these inflammatory deposits. Of the functional troubles, may be mentioned frequent and painful micturition, obstinate constipation and difficult defecation, contractures of the ilio-psoas muscles when the exudation is seated beneath the sheath or between the muscle and the pelvic bones, disturbances of motility in the abductor muscles, paresis of the lower extremities, and radiating pains in the upper portion of the thigh and in the renal and lumbar regions, produced by pressure upon the obturator, the crural, the cutaneous, and the sciatic nerves.

So long as fever is present, the exudation rarely diminishes. If absorption takes place in one point, growth almost certainly follows in some other direction. When, however, the apyretic period is reached, the exudation, as a rule, disappears rapidly, so that often in the course of six weeks no trace of its existence remains. In a smaller number, the solid mass may persist for months or even years.

After the fever has departed the patient usually feels well. The sleep and appetite return, the night-sweats disappear, the pulse often falls to 50 or 60 beats, and the temperature is in many cases, for a time, subnormal in character.

Where the fever persists for from five to six weeks, there is always a suspicion of abscess formation. With the exception of afternoon fever and night-sweats, the patient may feel very comfortable. Then the exudation becomes sensitive, the spontaneous pains recur, sleep is lost, and locomotion, defecation, and urination occasion acute suffer-

ing. The fever becomes violent, chills announce the presence of pus, and finally, about the seventieth or eightieth day, perforation of the abscess takes place. The usual seat at which the pus is discharged is just above Poupart's ligament; next, in frequency, perforation takes place into the colon, and in rare instances into the bladder, the uterus, and vagina. Fortunately, of very rare occurrence is the discharge of pus into the peritoneal cavity, which is naturally followed by acute peritonitis. Another likewise unfrequent but most dangerous accident is the septic infection of the abscess—an occurrence referred by Olshausen to the diffusion of intestinal gases through the walls of the tumor.

In suppuration of parametritic exudations the pus commonly forms in small scattered collections, and rarely gives rise to large abscesses.

Although parametritis and perimetritis are usually found associated together, there are always cases in which the one form of inflammation so far predominates over the other as to justify an attempt to establish a clinical distinction between them.

In the beginning of the attack, sharp pain, high fever, and tympanitic distention of the lower abdomen are symptomatic of inflammation in the pelvic peritonæum. Whether the cellular tissue is simultaneously implicated can only be determined by a digital examination after the abdominal sensitiveness has subsided. The absence of the objective signs of cellulitis would then contribute to prove that the case had been one in which the peritonæum had been in the main affected. On the other hand, moderate fever, pain elicited only on pressure, and tympanitic distention confined to the colon, coinciding with exudation between the folds of the broad ligament, would be indicative of a nearly pure cellulitis.

A palpable exudation is by no means the necessary product of peritoneal inflammation. Indeed, in many cases, the distinctive symptoms of the latter may be present for from four to eight days, and may then subside without leaving a trace of its existence at the pelvic brim.

The demonstration of a fluid effusion by noting the change of level, upon shifting the position of the patient, is rarely possible, either because the quantity is too small or because it quickly becomes confined by pseudo-membranous adhesions between the intestines.

Bandl * mentions as a sign of local peritonitis, sometimes noticeable, a number of resistant points or tumors near the pelvic brim or above one of the iliac fossæ, due to a matting together of the intestines or to their adhesion to the uterine appendages. They are distinguished from solid tumors by their emitting a tympanitic sound upon percussion, and by their changing position in consequence of an accumulation of urine in the bladder or of fæces or gases in the bowels. Again, all tumors may be reckoned as intraperitoneal which very rapidly form

* Handbuch der Frauenkrankheiten, red. von Billroth, 5ter Abschnitt.

behind or to the side of the uterus from inclosed exudation-products, and which at the same time rise far above the level of the pelvic brim. If, however, they start from the *cul-de-sac* of Douglas, and do not much exceed the linea terminalis, or if they occupy an iliac fossa, it becomes very difficult to decide whether they are of intra- or extra-peritoneal origin. The peritoneal exudation, however, long remains soft and fluctuating. It arises, as a rule, behind the uterus, and does not exhibit a tendency to spread to the sides or to the anterior or posterior pelvic walls.

Still more difficult is it to decide as to the seat of exudations met with beneath the abdominal walls. When diffused and continuous with a pelvic deposit, the diagnosis is uncertain. It is only safe to assume the peritoneal origin of extravasations of a rounded form, of a fluctuating consistence, and when they are situated high up and are disconnected from exudation at the pelvic brim. An opening of the abscess through the navel would indicate a peritoneal source, while the discharge through the abdominal parietes would point to a seat in the connective tissue.

After the perforation of an abscess, the fever and pain subside; the wound, if external, either closes in the course of one or two weeks, or fistulæ form which become the source of protracted suppuration.

In psoas abscesses, the exudation extends beneath the sheath of the muscle or between the iliacus and the bone. In puerperal patients, they proceed from an inflammation originating in the broad ligament. They are situated too deep to be easily palpated. The pains they occasion are referred rather to the hip or knee than to the abdomen. The contracture of the psoas muscle furnishes a diagnostic sign which distinguishes this form from the superficial abscesses of the iliac fossæ. The pus eventually is discharged beneath Poupart's ligament, in the lower portion of the inguinal fossa, at some point upon the crest of the ileum, or exceptionally along the thigh. Often the discharge is maintained for months.

The Symptoms of General Peritonitis (Suppurative).—This form generally begins with the usual symptoms of pelvic inflammation, but the tenderness, which at first was limited to the side of the uterus, gradually spreads over the entire abdomen. The abdominal pain is of a tearing, lancinating, sometimes colicky character. It is increased by the slightest bodily movement, by jarring of the bed, or even by the weight of the bedclothes.

As a consequence of the peritoneal inflammation and of the accompanying exudation, the muscular walls of the bowels become paralyzed, and tympanitic distention results from the accumulation of gases. In the dependent portions of the peritoneal cavity it is often possible to demonstrate, by percussion, the presence of fluid exudation, though distinct fluctuation is rarely to be made out. The size of the abdomen

is due much more to the tympanites than to the amount of effusion. Sometimes the liver, with the diaphragm, is pushed by the swollen bowels to the level of the fourth or third rib, and exercises such a degree of compression upon the posterior portion of the lungs as to place the patient in danger of suffocation. The respirations are jerky and attended with a moaning sound.

The loss of muscular power in the intestines permits the contents of the middle portion to pass unchecked toward the duodenum, and thence, upon accidental contractions of the abdomen, they may pass to the stomach and be ejected by vomiting. The first vomited matter has a dark-green color, and that ejected afterward presents the color of intestinal matter. Constipation at the outset may be subsequently followed by colliquative diarrhœa.

The fever begins, as a rule, though not always, with an intense chill, the temperature rises to 104°, and the pulse becomes small, hard, and resistant. Its frequency rapidly increases, varying from 120 to 160 beats to the minute. The skin is sometimes dry, sometimes dripping with perspiration. In fatal cases, as the end approaches, the temperature frequently falls, while the pulse becomes more rapid, the face assumes a pinched, anxious expression, sweat gathers upon the forehead, the extremities grow icy cold, and the patient dies in collapse. The duration of peritonitis averages not more than from four to six days.

In cases of recovery the pulse improves, the vomiting ceases, and the tympanites disappears. The diffuse exudation then becomes converted into circumscribed tumors, which, on palpation, are felt on the side of the pelvis and extending upward to the level of the umbilicus. Upon internal examination, the uterus is often found depressed by the weight of the fluid, which likewise may bulge the *cul-de-sac* of Douglas into the pelvic cavity. Sometimes the exudation may become encysted above the pelvis and leave the contents of the latter free. In still other cases, the uterus may become attached high up to the abdominal walls, so that the vaginal portion disappears and the os is reached with difficulty.

The peritoneal exudation may, as in pelvic inflammations, become absorbed and disappear. When, however, it is surrounded by loops of intestines, it is apt to undergo purulent and septic changes, and the abscesses may then become discolored and filled with stinking gases. The patient, whose previous improvement has been watched with delight, now loses appetite, the pulse becomes frequent, the strength fails, and death may follow from septic fever or from rupture of abscess into the abdominal cavity.

In the pyæmic form—a still more deadly variety of peritonitis—the symptoms differ materially from those which have been recounted. As, however, it constitutes only a single one of the pathological

changes connected with the poisoning of the blood through the lymphatic system, its consideration belongs properly to the study of the septic infection.

The Symptoms of Septicæmia Lymphatica (Septic).—The symptoms of blood-poisoning in the infectious diseases of childbed vary to a considerable extent according to the channel through which the septic germs enter the general circulation. In the murderous epidemics which prevail in lying-in hospitals the lymphatics are, as a rule, the vessels primarily invaded. It is to this form that the cases already described belong, where, with diphtheritic patches upon the utero-vaginal canal and sero-purulent œdema of the parametrium, there are associated pyæmic peritonitis and deformation of the blood-corpscules; or where, following the migrations of the round bacteria, the serous cavities become successively involved, septic vegetations gather upon the heart, and the glomeruli of the kidneys become choked with micrococci. The lymphatic form of septicæmia develops soon after labor, and is always ushered in by a chill. The temperature rises to 104° or even higher, and the pulse is thin and frequent. The abdomen swells rapidly, without being especially painful. Indeed, painless distention of the intestines is one of the characteristics of an acute invasion of the lymphatics. Peritoneal effusion is absent in cases which run a rapid course, and is distinctly recognizable only in a peritonitis of long continuance. The effusion is not so much due to exudation as to a transudation of serum with which micrococci are commingled. At the same time the tongue is moist, but slightly coated, and at times quite clean. Sometimes there is diarrhœa, due to catarrh or to a diphtheritic affection of the colon. When the bowels have been constipated, the administration of a purgative may provoke discharges which it may be found difficult to arrest. The skin is bathed in perspiration. At the beginning and during the course of the disease, bleeding at the nose is not of infrequent occurrence.

Toward the end, the pulse runs up to 140 to 160 beats, while in many cases the temperature falls. Immediately after death the heat of the body may for a short time exceed the highest point reached during life. The respirations are superficial and jerky. In many instances the face, the neck, and the fingers are blue from defective oxygenation of the blood. At the same time, the skin becomes clammy and the extremities cold.

The sensorium, in cases which run a rapid course, is usually affected at an early period. The patients appear somnolent, are restless in bed, have light delirium, and respond only when spoken to loudly. As a rule, they make but little complaint, and, were it not for the dyspnœa, would have nothing to disturb their sense of comfort. Very few, even as death approaches, have any idea of the danger that threatens them. Now and then, in place of stupor, great restlessness,

and even a maniacal condition, is developed. Albumen is usually found in the urine.

Pleurisy, so frequently associated with lymphatic septicæmia, is frequently double, more rarely single, and begins, as a rule, with sharp pain in the side and an aggravation of the previous dyspnœa. Pericarditis is less frequent, and occurs usually, without symptoms, toward the close of life. The joint affections are characterized by redness and swelling, and by pain, which is sometimes so great that touching the inflamed part suffices to arouse the patient from sopor. Sometimes fluctuation is felt, but death occurs before perforation and discharge of the pus.

The most frequent ending is death, which follows in from two to twenty-one days, and, as a rule, between four and seven days. Recovery is, however, possible.

The Symptoms of Septicæmia Venosa (Phlebitis uterina, Pyæmia metastatica).—The putrid infection of a thrombus at the placental site may take place within twenty-four to forty-eight hours after labor. Usually, however, the approach is insidious, and the disease develops from an apparently insignificant endometritis or parametritis; or the patient, with the exception, perhaps, of a tired feeling, of slight chilly sensations, and of profuse perspiration, may not have been conscious of any indisposition for days preceding the attack, or even until the first getting up from childbed. The initial chill, in typical cases, is characterized by its violence and duration. In some cases it may last for hours. It is accompanied and followed by high temperature, the febrile attack ending with profuse perspiration as in intermittent fever, with which it is apt to be confounded. The fall in temperature often assumes the form of a prolonged remission.

In many cases, the pulse rises and falls with the variations in the body heat, while, in others, it remains permanently above the average. A frequent pulse is always a suspicious symptom in childbed, even where the other symptoms are apparently normal.

Erratic chills announce the lodgment of emboli in distant organs. With the formation of metastatic abscesses in the lungs and other parenchymatous organs, the typical character of the disease changes. In place of chills occurring at irregular intervals, followed by remissions and periods of apparent improvement, the fever is continuous, the pulse becomes small and rapid, while sopor, slight delirium, a dry skin, a dry, brown, cracked tongue, and a moderately tympanitic abdomen, give the case the appearance of one of typhus fever.

Peritonitis is present in hardly one third of the cases. The abdomen is therefore flat and soft, and often is not sensitive upon pressure. Icterus, due to disintegration of the blood-corpuscles, is an ominous symptom.

Death usually occurs in the second or third week. In the typhus-

like cases, however, it may follow the first attack speedily. Recovery is possible where the organs secondarily affected are not of too great importance.

A combination of the lymphatic and venous forms of septicæmia is not uncommon in cases running a protracted course.

The Symptoms of Pure Septicæmia.—Under the title of pure septicæmia should be placed cases in which the absorption of morbific materials into the blood gives rise to symptoms of intense blood-poisoning without the development of local lesions. A common example of this form is met with in the fever which results from the presence in the uterus of decomposing coagula or portions of retained ovum, the fever subsiding with the removal of the disturbing cause. The symptoms are often similar to those produced by the injection of putrid materials containing rod-like bacteria into the vessels of animals. As the long bacteria do not possess the capacity of self-reproduction in the blood, to produce fatal results the quantity of putrid fluid injected must be large or be frequently repeated. This form is said not to be inoculable. In like manner we sometimes meet with cases of intense septic poisoning followed by speedy death, in which the *post-mortem* examination reveals only changes in the blood and softening of the parenchymatous organs.

CHAPTER XXXVI.

PUERPERAL FEVER (Continued).

Causes.—The atmosphere.—Inoculation.—Season of the year.—Social state.—Relations to zymotic diseases.—The prevention of puerperal fever.—Treatment.—Vaginal and uterine injections.—Iodoform bacilli; opium; leeches; stupes; laxatives; quinine; salicylate of sodium; Warburg's tincture; veratrum viride; digitalis; antipyrine; alcohol; cold.—Treatment of peritoneal effusions and inflammatory exudations.

Causes of Puerperal Fever.

The Atmosphere.—Micrococci multiply in hospitals when organic materials favorable to their growth are present in sufficient quantities. Perrin, Quenquand, and others have shown that the hospital wards in Paris, especially those upon the surgical and maternity divisions, contain an infinite number of vibrios, bacteria, and all the coccus forms (Charpentier). Robin has demonstrated the existence of albuminoid matters in water condensed upon vessels containing freezing mixtures and placed in overcrowded wards of hospitals. When the results of crowding become manifest, these albuminoid matters not only impart a fetid odor and putrefy with great rapidity, but rapidly impart putrefaction to healthy muscle and normal blood with which they are

brought into contact. Pasteur was able, by the microscopic examination of the lochia from patients in the services of Hervieux and Lucas-Championnière, to predict, from the character of the contained organisms, an impending attack of fever in advance of the slightest symptom betokening danger.

The quality of the agents which pervade the air where hospital patients are confined is an important element in the genesis of febrile outbreaks. The bacterium termo, which causes putrefaction, is not in itself, as we have already mentioned, a source of danger. A stinking odor is not necessarily incompatible with a low mortality rate. The importance of the common forms of bacteria, according to Pasteur, results from the fact that by their power to consume oxygen they pave the way for the active development of the pernicious germs, nearly all of which thrive only in media in which that element has been materially diminished. Again, there is reason to believe that the same germs are not always equally active for evil. The resistance of micrococci to carbolic and salicylic acids is found, experimentally, to depend in a measure upon the nature of the vehicle in which they are cultivated (Buchholz). The action of septic fluids varies, too, with the age of the infusions, with the materials employed, and with the conditions under which the poison-germs are generated.

It was unquestionably the lochial discharge which, before the days of antisepsis, made it such a difficult task to keep a maternity ward in a healthful condition. Putrid blood has been found to be the most favorable material for septic experiments. In the summer months, so long as the windows were open and the air was diluted by the continuous passage of fresh currents, the patients usually enjoyed immunity from puerperal fevers. In the autumn, so soon as it became necessary to close the windows partially, on account of the cool nights, it was not uncommon for the more trivial disturbances, such as so-called milk fever, the hospital pulse, and catarrhal affections of the genitalia, to manifest themselves. Through the months of February, March, and April the mortality was usually greatest. During the winter months there was, as a rule, crowding of patients, insufficient ventilation, stagnation of the air, and the rapid accumulation of disease-germs. That the later winter months should prove the most perilous is in accordance not only with the theory of continuous accumulation, but with the experimental fact that weeks sometimes elapse before a decomposing substance acquires the highest degree of virulence.

Apart from the nosocomial malaria of hospitals, there is reason to believe in the influence, at times, of certain general widespread atmospheric states which affect the entire community. In the year 1871 the mortality from childbed in New York was 399; in 1872, 503; in 1873, 431; in 1874, 439; and in 1875, 420. Now, the excess in the deaths for 1872 was due wholly to an increase in the cases of metria,

those from ordinary accidents remaining nearly the same as in the preceding years. The disease certainly did not extend into the city from the hospitals serving as foci, for the mortality at Bellevue Hospital was hardly more than half the usual average. There was no especial mortality that year from either diphtheria, erysipelas, or scarlatina, but the aggregate mortality was the largest known in the history of the city. There are no positive data connecting the civil deaths from puerperal fever in 1872 with parasiticism, but the prevalence of epizoötics, of epidemic catarrhal affections, of peculiarly fatal forms of pneumonia and other diseases which are now attributed to the presence of minute organisms in the atmosphere, renders such a source highly probable.

It is proper to say here that, though the argument is very strong in favor of regarding the genitalia of puerperal women as the exclusive point of entry of infectious materials into the system, it seems impossible at the present time to make all the facts coincide with such a theory. I have the records of a number of cases occurring during an epidemic of puerperal fever in which patients were either attacked with fever previous to parturition, or in whose cases the unusual length of labor, the frequency of *post-partum* hæmorrhage, and the imperfect contraction of the uterus immediately after confinement, were signs of some abnormal influence exercised upon the economy at an early period of labor previous to the existence of traumatism. That deleterious materials may find other channels for entering the system than a wounded surface is evidenced by the cachectic condition not unfrequently produced in physicians by too assiduous attendance in dissecting-rooms and places in which *post-mortem* examinations are conducted. One severe and rapidly fatal case of puerperal fever which occurred in Bellevue Hospital I find it impossible to attribute to any other cause than that the woman, for five months previous to her confinement, served as a helper in a lying-in ward. The *post-mortem* examination disclosed no special local lesions, but her symptoms were those of intense septicæmia. French writers report instances of toxæmic conditions developing in young midwives during puerperal-fever epidemics. While we are not prepared to go as far as Tarnier, who says, "It is probable that the lungs, by their extent and activity, offer conditions most favorable to absorption, and that often, if not always, it is by them that poisoning occurs," it does not yet seem time to give up the idea that, under exceptional circumstances, the respiratory and the digestive tracts may allow the passage of materials of a septic character.

Inoculation.—Unquestionably the most frequent source of puerperal fever is by inoculation; and yet, no longer than thirty years ago, the doctrine was combated as a pernicious heresy by both Meigs and Hodge, of Philadelphia, at that time regarded as the best authorities

upon obstetrical questions in this country. Hodge, addressing his students, said: "The result of the whole discussion will, I trust, serve not only to exalt your views of the value and dignity of our profession, but to divest your minds of the overpowering dread that you can ever become, especially in women under the extremely interesting circumstances of gestation and parturition, the ministers of evil—that you can ever convey, in any possible manner, a horrible virus, so destructive in its effects and so mysterious in its operations as that attributed to puerperal fever"; and Meigs, in his letters to students, writes: "I prefer to attribute them to accident or to Providence, of which I can form a conception, rather than to a contagion of which I can not form any clear idea, at least as to this particular malady." Contrasted with these rhetorical utterances, in an essay published in 1843, by Prof. Oliver Wendell Holmes, entitled "Puerperal Fever as a Private Pestilence," the opposing testimony in favor of contagion was presented with equal literary and scientific skill. The evidence was complete and conclusive, and has exercised a most beneficial influence upon the practice of midwifery in America. With his many claims to our admiration and esteem, there is probably no title which Professor Holmes wears with greater pride than that of pioneer in a movement that has done so much to prevent the slaughter of innocent women and the wrecking of happy homes.

The ordinary carriers of infection are unquestionably the unclean hands, instruments, utensils, clothing, wash material, and the like which are brought in contact, during or after labor, with the genitals of the female.

Barnes and other English writers lay considerable stress upon cases of puerperal fever due neither to contagion nor to atmospheric conditions, but to the poisoning of the patient by her own secretions. There is justification for this view in the fact that even normal lochia contain bacteria, and, when inoculated into animals, produce in them affections of an ichorrhæmic and septicæmic nature. When death takes place, the tissues of animals thus treated are found to be filled with round bacteria. Furthermore, the disease artificially produced is in itself infectious, and can be continuously propagated in other animals. But it may be asked, "Does not this admission cut both ways? How is it possible, if even normal lochia possess virulent qualities, that childbed is ever unattended by accessions of fever?" To this we can only answer that the reasons for immunity in ordinary cases are only known in part. Karewski * and other experimental investigators have shown that the virulence of the lochia increases proportionately to the number of days that have transpired since the birth of the child, and

* Experimentelle Untersuchungen über die Einwirkungen puerperaler Secrete auf den thierischen Organismus, Zeitschr. f. Geb. und Gynaek., Bd. vii, 2ter Th., S. 331.

that, during the first three days, the lochia are comparatively harmless. Meantime, the retraction of the uterus, the closure of the sinuses, and the formation upon the wounded surfaces of protecting granulations, all act as natural barriers to the penetration of poison-germs. But, aside from these reasons, there is undoubtedly an unknown quantity calling for further investigation, which, in the absence of positive knowledge, we are content to term the predisposition of the individual patient. The vagina after childbirth possesses all the conditions most favorable for the production of putrefaction, viz., the access of air, fostering warmth, and stagnating fluids charged with dead tissue. It is probable that the first of these needful conditions is, in normal labors, happily wanting in the uterine cavity. In these days of intra-uterine medication it is well to bear in mind the relatively greater frequency of infection through vaginal and cervical wounds, as compared with that which takes place through the denuded intra-uterine surface. The term auto-infection may, with propriety, be employed as a distinctive appellation to designate those attacks of fever which, in the absence of any demonstrable cause, occur in the early days of childbed, and which there, *quoad vitam*, pursue a favorable course, and to cases of so-called late infection—i. e., where, after the fifth day, the accidental opening of a healing wound permits the tardy absorption of poisonous secretions; but with the reserve that the primary cause is, in point of fact, atmospheric, and the predisposing condition the susceptibility of the individual. Cases of auto-infection are in this country extremely rare, if not unknown altogether, in salubrious or rural districts.

Seasons.—On another occasion I have shown that in New York city the death-rate from puerperal fever is nearly twice as great during the six months from December to May, inclusive, as from June to November. The greatest mortality occurred in February and March, comprising rather more than one fourth the entire amount. The smallest number of deaths occurred in September and October, in which months but one thirteenth of the entire number took place.

Social State.—That puerperal fever, in its harvest of death, does not spare the wealthy and well-to-do classes is too familiar a truth to be worthy of discussion. That, however, the wealthy do enjoy special immunities as compared with the less-favored members of society, I have shown by comparisons made between sections of the city which, though lying side by side, exhibit in a marked degree the two extremes of wealth and poverty. Thus, the mortality among the representatives of the lower social strata, in proportion to population, was from three to six times as great as that among the more fortunate classes.

Relations to Zymotic Diseases.—In investigating, some years ago, the nature, causes, and prevention of puerperal fever,* I prepared,

* Trans. of the International Med. Congress, Philadelphia, 1876.

from the statistics of the Health Board of New York city, tables extending over a period of nine years to answer the inquiry as to whether there was any relation between the frequency of deaths from scarlatina, diphtheria, and erysipelas and those from metria. Previous to their publication, I was anticipated in my deductions by a paper upon the same subject by Matthews Duncan.* Neither Duncan nor myself found any such relation existing between the statistical frequency of puerperal fever and the zymotic diseases mentioned. There was, however, nothing in our investigations to invalidate any direct testimony which tends to show that, in individual cases, a real connection between puerperal fever and the zymotic diseases may exist. Indeed, it seems to me to be fairly established that a poison may be conveyed from patients suffering from either of the foregoing morbid processes which may be absorbed by the puerperal woman, and may, in her, give rise to an infectious fever possessing an intense degree of virulence.

Prevention.—Doléris formulates the indications for effective prophylaxis as follows: 1, prevent the introduction of germs (antisepsis before confinement); 2, paralyze their action (antisepsis after confinement); 3, shut up the doors—veins, lymphatics, and Fallopian tubes (employment of means which promote uterine contraction).

The results in the application of these rules are best shown in the modern statistics of lying-in hospitals. The records of the Health Board between the years 1868 to 1875, inclusive, showed that at that time nearly one sixth of the deaths from metria in New York city were contributed by the hospitals. To cite a single example: In the year 1873 there were 449 births in Bellevue Hospital; there were 25 maternal deaths, 15 of which were the result of septic infection. The proportion of one death from sepsis to thirty cases of childbirth was at that time the usual one in the maternities of this country and of Europe, reported differences being rather of bookkeeping than of fact. There was always, likewise, a large unreckoned contingent of patients with pelvic inflammatory troubles which ended in recovery. In 1874, between the 1st of January and the 11th of June, of 166 patients confined, 31 died of puerperal fever. Similar fatal epidemics were, at that time, of not infrequent occurrence in the best appointed maternities.

During the years 1885 to 1889, inclusive, 837 women have been confined in the Emergency Hospital, and there have been 16 deaths, i. e., nearly 1 to 82. A glance at the record shows that these cases are the best illustrations of the difficulties with which the institution has to contend, and of the value of the antiseptic principle.

* On the Alleged Occasional Epidemic Prevalence of Puerperal Pyæmia, or Puerperal Fever and Erysipelas, Edinburgh Med. Journal, March, 1876, p. 774. Recent observations have shown that morphologically the streptococci of erysipelas and those of puerperal fever are indistinguishable.

Thus, there were five deaths from eclampsia. The patients were all sent to the hospital after the convulsions had gained full headway.

One was a case of placenta prævia. The labor had been lengthy and the hæmorrhages profuse before the patient was admitted.

One was a case of Cæsarean section, performed on account of the obliteration of the cervix and vagina by cancer.

A patient was sent to the Emergency in labor, with delirium tremens. She died twenty-four hours after delivery.

There were two deaths following version in neglected shoulder presentations. Both women had been in labor several days previous to admission. The children were dead, and decomposition had set in.

In two cases the women had been respectively two and one half and four days in labor when admitted. The children were dead. There was a stinking discharge and commencing decomposition of the fœtus.

In two cases the high-forceps operation had been performed surreptitiously by unqualified persons. In both instances, the lower uterine segment was ruptured, and death speedily followed.

In a twin pregnancy, where one child was delivered by forceps and the second by version after a long labor, death occurred from septicæmia.

There remains one other case, concerning which no record has been preserved.

Thus, of the sixteen deaths, one, or possibly two, can be construed as due to puerperal fever.

I have ventured to offer these particulars because there is no pretense that the Emergency is a model for imitation. It has no fans for ventilation; no provision for a rotation of wards. It is intended for the homeless class. It receives constantly women with high temperatures due to infection before their entrance, or who have been days in labor, or who have been subjected to unavailing attempts at artificial delivery by outside physicians. It therefore furnishes an excellent test of the value of modern antiseptic methods.

Now, the regulations by which these results have been obtained are comparatively simple. The patient, on her entrance into the hospital, receives a full bath. A rectal injection is given. The lower abdomen, the inner surfaces of the thighs, the pudenda, and the anus are scrubbed with soap and water, then washed with plain water, and finally cleansed with a 1 : 1,000 solution of corrosive sublimate. The vagina is first douched with soap and water, and then with a 1 : 5,000 solution of corrosive sublimate. In operative cases these douches are repeated before and after the introduction of the hand or instruments. The Bellevue Hospital internes, while on duty, are not permitted to visit the dead-house or the erysipelas pavilion. They are not allowed to assist at surgical operations, nor to take part in the dressing of wounds. When in attendance upon a case of labor, both interne and

nurse wash their hands and forearms with soap and water, with pure water, and with corrosive-sublimate solution (1 : 1,000). Before an internal examination is made, the hands are freshly washed with the bichloride solution. Infrequent examinations are recommended. Instruments are placed in a 2-per-cent solution of carbolic acid. After they have been used, they are boiled and polished for future service.

The Credé method of expelling the placenta is employed. Ergot is given to secure good uterine contractions. In all cases after labor the vagina is douched with the bichloride solution (1 : 5,000). In cases of protracted labor, of high-forceps operation, of version, or of any manipulations by means of which air is admitted to the uterine cavity, the douche, after preliminary vaginal irrigation, is extended to the uterine cavity. The external parts are then dusted with iodoform, and are covered with a piece of gauze freshly wet with bichloride solution (1 : 5,000). Outside is placed a pad of oakum. The dressing is changed once in six hours, at which time the genitals are scrupulously cleansed. During childbed no vaginal douches are given.

In the main, the plan of treatment carried out is that introduced by Garrigues at Charity Hospital five years ago. Its success is attested not only by the absence of deaths due to septic infection, but by the morbidity in the wards. The temperatures rarely rise above 100½°, and, as a rule, do not reach 100°. But the plan of treatment presupposes intelligent instruments. For us these are supplied, on the one hand, by the training-school for nurses; on the other, by the hospital interne, who enters upon his duties thoroughly familiar with the requirements of surgical cleanliness. The occasional appearance on the scene of an individual who uses his "common sense"—i. e., one who does not believe there is any harm in witnessing an autopsy, or in visiting a companion in the erysipelas ward, or in holding the pus basin in an operation for pyo-thorax—is almost certainly followed by temperature elevations, which add fresh testimony to the efficacy of a rigid observance of antiseptic regulations.

It is, however, to be acknowledged that there is by no means unanimity among authorities in relation to certain of the rules prescribed. Thus, the pad to the vulva is sneered at, by many, as savoring of the heresy that the air can become the source of contagion. For my own part, I believe an antiseptic dressing and pad are of immense service in hospital practice, where patients are aggregated together, as a means of preventing the decomposition of the lochia. The latter is inevitable upon the external parts when the ordinary napkin is employed. It seems to me incontrovertible that the air does thereby become contaminated, and it is doing violence to the evidence to deny the pernicious influence of a germ-laden atmosphere upon puerperal wounds. The argument that such an admission has a tendency to weaken the personal responsibility of the physician is childish. Aside from the fact

that science is based upon truth, and not upon teleological considerations, the belief in a twofold origin of puerperal fever simply doubles his responsibility. To be sure, Leopold* found that of 427 patients in the Dresden Maternity, who had not been examined or treated with corrosive sublimate previous to confinement, only 7 had a rise of temperature, and this fact taken by itself would seem to indicate that direct contact alone is capable of producing infection. But these patients were confined under favorable sanitary conditions. Szabo,† on the contrary, during an epidemic of fever in the Pesth Maternity, gave orders that no examinations should be made. Of 90 patients confined under these conditions, more than one third had febrile disturbances; and two of the patients, upon whom, in one case, sutures and, in the other, serres-fines were employed for perineal laceration, died. The researches of Ott‡ and Thomen* show that in healthy women the bacteria contained in the lochia are found, not in the upper portion of the vagina, but near the introitus, which would certainly indicate that they are ordinarily derived from external sources. At any rate, since the use of the pad at the Emergency Hospital, it has been possible to do away with the old-time rotation of wards, and the febrile temperatures, which once were so marked a feature of the winter months, when the windows were closed, are now no longer observable.

The subject of prophylactic douches, during labor, has likewise been one of endless contentions. In private practice they are certainly needless. Their employment at the Emergency has not, however, been the result of theory, but has been the outcome of the condition of the patients admitted, most of them having been examined previously by not overfastidious midwives or physicians.

The differences which divide obstetrical authorities concerning the ante-partum douche is not so much the result of conflicting experiences as of doctrinal convictions. Thus, Barnes, Ahlfeld, Kaltenbach, and others, have shown that, in spite of every pains taken to exclude contact-infection, temperature elevations will occasionally occur in childbed. These febrile disturbances they regard as the product of a *materies morbi*, existent in the genital canal prior to labor; or, to use a term which at present is not only a designation, but a war-cry, such cases are due to auto-infection. It is a matter of common agreement that, in severe cases of puerperal infection, the utero-vaginal canal swarms with bacterial forms, and that, of these, the streptococcus pyogenes is the most certain accompaniment of specific inflammatory

* Leopold, Dritter Beiträg zur Verhütung der Kindbiltfiebers, Archiv f. Gynäkologie, vol. xxxv, p. 149.

† Szabo, Zur Frage der Selbstinfection, *Ibid.*, vol. xxxiv, p. 153.

‡ Ott, Zur Bacteriologie der Lochien, *Ibid.*, vol. xxxii.

* Thomen, Bacteriologische Untersuchungen Normaler Lochien, etc., *Ibid.*, vol. xxxvi, p. 247.

troubles. When convalescence sets in, the coccus forms correspondingly disappear from the lochial discharges. But the vagina at all times contains a varied assortment of bacterial germs. Nothing would seem simpler, therefore, than the deduction that these germs are always potential sources of evil. As a logical outcome of this doctrine, its extreme supporters insist upon a complete sterilization of the vagina in every case of labor as an ordinary prophylactic precaution. Thus, Steffeck * advises the irrigation of the vagina during labor, at two-hour intervals, with a litre of corrosive-sublimate solution. To increase its efficiency he introduces two fingers into the vagina to scrub, during the douche, first the vaginal mucous membrane and then the interior of the cervix. Döderlein † recommends that the vagina be first rubbed thoroughly with a preparation of creolin and mollin, and then be irrigated, for ten minutes, with a creolin solution.

Fortunately, these suggestions, which would have a tendency to handicap fatally the employment of antiseptic measures in midwifery, have not been received with much favor, even by the partisans of the doctrine of auto-infection. But, on the other hand, the pathogenic character of the germs contained in the vagina has been disputed. Thus, Artemieff ‡ says that "the lochia of perfectly healthy puerperal women contains no micro-organisms." Bökelmann # maintains that a healthy, normal puerperal woman is *a priori* to be regarded as aseptic. He objects to attempted sterilization on the ground that the measures employed mechanically delay the progress of labor by the removal of the normal vaginal mucus, and at the same time render more vulnerable the tears, the excoriations, and the surfaces from which the epithelium has been detached.

Kaltenbach,‖ although a defender of auto-infection, states that in easy, rapid, births the germs are carried away by blood, amniotic fluid, and the passage of the child; but in tardy labors, or in case of the premature rupture of the membranes, the entrance of germs into the uterine cavity is facilitated, and many may remain in the uterus and become a source of danger. Diseases resulting from auto-infection are lighter in character than those due to inoculation. Infection is first preceded by putrefaction. A complete destruction of germs is unnecessary; those that remain *in utero* are rendered harmless by ordinary injections. Even Winter states that, in the present condition of our

* Steffeck, Ueber Disinfection des weiblichen Genital-canals, Zeitschrift für Geburtskunde, vol. xv, p. 395.

† Döderlein und Günther, Disinfection des Geburts-canals, Archiv für Gynäkologie, vol. xxxiv, p. 111.

‡ Artemieff, Micro und bacterioscopische Untersuchungen der Lochien, Zeitschrift f. Geburtskunde, vol. xvii, p. 174.

Bökelmann, Die Antisepsis während der Geburt, *Ibid.*, vol. xvii, p. 341.

‖ Kaltenbach, Archiv f. Gynäkologie, vol. xxxv, p. 489.

bacteriological investigations, it is not right to carry out the attempts at complete sterilization recommended by Steffeck and Döderlein.

In private practice, under ordinary conditions, the presence in the vagina of infectious forms of bacteria is hardly conceivable, except in cases where they have been directly imported by the finger or by instruments. This statement is based both upon microscopic investigations and upon clinical experience. So far, it has not been possible, in the rare instances where beaded cocci have been found in the vaginal secretions, *ante-partum*, to obtain by pure cultures a product capable of giving rise to spreading inflammations; and in rural districts, even with not overcleanly surroundings, immunity from infectious puerperal diseases is the rule. That, however, the vagina, which is not a hermetically closed tube, should, like the atmosphere, contain germs capable of producing putrefaction is hardly doubtful. Under healthy conditions the uterine cavity, on the contrary, contains no bacterial forms, and it is not invaded by them in normal parturition, a fact attributed to their feeble migratory power and to the downward current of the secretions. Conditions which favor the passage of germs from the vagina into the uterus are relaxation of the uterine walls, and membranes hanging from the cervix. The increased morbidity which accompanied the once popular vaginal douche in childbed was doubtless owing to the circumstance that, while of feeble disinfectant power, the injected stream furnished in many instances a direct highway to the uterine cavity. True midwifery antisepsis consists not so much in douching as in furthering physiological processes. Under normal circumstances, a proper handling of the patient during labor will effect more in the way of prophylaxis than the most effective germ-destroying agents. When, however, hands or instruments are introduced into the uterine cavity, the case is different. It would be hardihood then not to precede the operative measure by thorough vaginal disinfection.

In private practice too great pains can not be taken with the sanitary surroundings. The sheets and the napkin or pad to the vulva should be matters of personal supervision. Slovenly laundry work is dangerous. I prefer the pad because it is destroyed after having been once in use. The employment of napkins which have been left in a pail until putrefaction is well advanced, and are then soaked and dried before the fire by the monthly nurse, is a familiar procedure, and a direct temptation of Providence.

In city homes close inquiries should be made in reference to the condition of closets and sewer connections. My attention was first drawn to the similarity of typhoid and septic fever in puerperal cases by a patient sent to the hospital in a moribund condition. Her child had been removed by a high-forceps operation, and the cervix was badly lacerated. I regarded her symptoms as typical of puerperal fever, but the *post-mortem* examination showed a perfectly healthy condition

of the pelvic organs and the characteristic intestinal lesions of typhoid. During the years of low water supply in New York, I have many times been called to see patients with high fever who were undergoing the customary douchings, while, in the adjoining closet, the basin into which the dejecta of the patient were being thrown was washed out, once or twice daily, by a pitcher of water poured into the basin by hand. The dangers of defective house sanitation have been ably presented by my friend Professor Playfair, and I find it difficult to understand the attitude of those who find no harm in the condition I have described because, they say, it does not affect the drinking water.

A physician from the country called upon me to consult me about an epidemic of puerperal fever in his practice. I asked him many questions, but received no enlightening answer as to the cause. The physician was intelligent, and had seemingly taken every needful precaution. As he was about to leave me I inquired whether there was any diphtheria in his neighborhood. He answered, he had "lots of it," and seemed surprised that I should connect the diphtheria and puerperal fever together. It seems to me a thoroughly false idea that a physician can attend erysipelas, diphtheria, and scarlet fever, and at the same time pursue his midwifery practice with impunity, provided he makes free use of corrosive sublimate and carbolic acid. Indeed, I am almost disposed to regard as a special form of blindness the prevalent faith that parturient and puerperal women can only be infected by the finger and through the vagina.

Treatment.—When the germs characteristic of septic infection have once entered the tissues they are beyond the reach of the physician. Except, however, in cases of acute septicæmia, where the quantity of poison introduced into the circulation at the outset is excessive, the patient rallies from the immediate shock, and, provided no fresh pyrogenic material finds its way into the system, recovery is to be anticipated. The indications for treatment are, therefore, to neutralize the puerperal poison at the point of production, in order to prevent its causing further mischief, and to adopt measures calculated to enable the patient to tolerate its presence, when once absorbed, until it is either eliminated or loses its harmful properties.

Toward the fulfillment of the first indication it is to be recommended that, in every case of fever of puerperal origin, the vagina be cleansed with a 2 to 3 per cent solution of carbolic acid or corrosive sublimate (1 : 3,000) every four to six hours. The douche in itself is absolutely harmless. To avoid carbolic or corrosive-sublimate poisoning, it is, however, necessary to make sure that no portion of the injected fluid be retained in the vagina. In most cases the infection starts from the wounds of the vagina and of the cervix. Then, too, the tendency of the secretions to stagnate in the vaginal *cul-de-sac*, bathing as they do the cervical portion, is a prolific source of septic

trouble. In all but the mildest cases the vaginal orifice should be examined with reference to the existence of puerperal ulcers. All necrotic patches should be touched with hydrochloric acid, with a 10-per-cent solution of carbolic acid, with iodoform, or, what I personally prefer, a mixture composed of equal parts of the solution of the persulphate of iron and the compound tincture of iodine. The latter acts as a powerful antiseptic, while the former, by corrugating the tissues, closes the lymphatics and shuts up the portals through which the septic germs penetrate into the system.

Intra-uterine injections, in spite of the prevalent belief that they constitute the rational treatment for puerperal fever, should be resorted to with extreme circumspection, as they interfere with the localizing processes by which most of the pelvic inflammations become self-limited; they help to extend the morbid condition of the uterine cavity to the tubes, and, if continued long enough, they paralyze the uterine walls, so that after death the fundus is found to contain a dirty pool alive with bacteria.

Runge reports an epidemic of puerperal fever in Gusserrow's clinic brought about by the employment of intra-uterine irrigations, during which the mortality rose to 3·8 per cent. With the abolition of the irrigations the mortality sank to ·39 per cent. In 1880 Fischel introduced the so-called permanent irrigations into the Prague Maternity. Of 880 patients, 9 died of sepsis. The irrigations were then prohibited. The following year, of 933 patients, only 2 died from the same cause, and in 1882, of 521 patients, there were no deaths from sepsis. Fehling, who limited the use of intra-uterine injections to special momentary indications, reported, in 1880, 415 confinements without a single death. Unless the infection proceeds from the uterine cavity, they are unnecessary. Nor must it be forgotten that puerperal women are not exempt from febrile disorders other than those due to sepsis. Before the douche is used the breasts should be examined. The douche can help but little in acute and suppurative inflammations awakened by labor, and in patients who have had chronic unilateral salpingitis antedating pregnancy. In cases of true puerperal infection, due to the penetrative form of micrococci and associated with spreading forms of inflammation, the use of the douche is probably idle, and no more effective than washing the surface of the skin in an external erysipelatous process; and yet it is common to persist in the practice in spite of negative results.

The employment of the douche in fevers resulting from the absorption of toxine due to the putrefaction of clots, membranes, and bits of placenta within the uterus, on the other hand, is followed by immediate favorable results, and by the prompt disappearance of danger. But it is to be remembered that this is a clumsy attempt to remedy the results of past remissness.

The indications for the douche as popularly employed are especially vague. One man is governed by the odor of the lochia, but the odor in ordinary catarrhal endometritis is offensive, and yet all such cases recover unless aggravated by the douche. Again, as Bumm has pointed out, the products of tissue disintegration may be virulently poisonous and yet the odor may be absent. Others, again, use the douche when the temperature reaches 102°. But the temperature-guide leaves out of sight the multitude of temporary temperature elevations due to trivial local troubles, to psychical causes, and to malaria.

The operation of cleansing the uterus should be conducted with the most scrupulous care. The syringe employed should produce a continuous and not an interrupted stream, and all air should be expelled from the pipe. The tube to be passed through the cervix should be of glass, of the size of the little finger, and bent somewhat to conform to the pelvic curve. The vagina should first be subjected to a thorough disinfection, by way of precaution against conveying septic materials into the uterus. The introduction of the tube should be made with the guidance of two fingers passed through the external os. But slight force is requisite to reach the internal os. It is neither necessary nor desirable to push the tube to the fundus. The fluid injected should be tepid, and, if carbolic acid is used, of the strength of two or three drachms to the pint; if corrosive sublimate is employed, the strength should not exceed 1 : 3,000. It should be introduced very slowly, and pains should be taken to insure its unimpeded escape, which can usually be accomplished by pressing the anterior wall of the cervix forward by means of the glass tube.

I would strongly recommend, after the douche, the introduction of the iodoform bacillus of Spaeth and Braun. The formula recommended consists of—

℞ Iodoformi..... 20 grammes.
Gummi Arabici,
Glycerinæ,
Amyli puri..... āā 2 grammes.
Ft. Bacilli..... No. iij.

If the fever persists, it is sometimes desirable to follow the advice of Doléris and of Braun von Fernwald, and explore the uterine cavity with the curette for retained bits of tissue. But it is time to stop treatment at this point. There is nothing more fatuous than the expectation of curing the patient by redoubling the vigor of the treatment.

Of the symptoms, the first in order which calls for treatment is usually the peritoneal pain. It is, as we have seen, commonly of a lancinating character, and is associated with hurried breathing and extreme frequency of the pulse. So soon as the pain is once fairly under control, the violence of the onset begins to abate. It should be

met, therefore, by the hypodermic injection of from one sixth to one third grain of morphia in solution. The anodyne action should be maintained by doses administered by the mouth in quantities and at intervals suited to the severity of the case. The most important object to be secured is freedom from spontaneous pain. It is, moreover, good practice to push the opiate until pain elicited by pressure is likewise controlled, provided it can be accomplished without producing narcosis. In susceptible patients and in localized inflammations the quantity required may not be very great, while, in acute general peritonitis, the tolerance of the drug exhibited by puerperal women is sometimes extraordinary. Thus, a patient of Alonzo Clark took the equivalent of 934 grains of opium in four days; a patient of Fordyce Barker, 13,969 drops of Magendie's solution in eleven days; and one of my own, at the Maternity, the equivalent of over 1,700 grains of opium in seven days.* In this latter instance the patient was to all appearance moribund when the treatment was begun. Thus, the features were pinched, the face was drawn, the pupils were dilated, the finger-tips were blue and cold, the respirations were rapid, and the pulse was scarcely perceptible. In this condition the large doses of opium did not produce narcosis, but were followed by restoration of the circulation, by normal breathing, and by the disappearance of the symptoms of shock. Any attempt to relax the treatment was at once succeeded by a recurrence of the alarming symptoms. At the expiration of the disease, the opium was discontinued abruptly without detriment to the patient.

In contrast to cases of acute peritonitis, an extreme susceptibility to opium is often observed in the pyæmic variety. Here opiates seem to me rarely to do good. They do not hinder the migrations of the round bacteria, there is rarely pain to relieve, and I have sometimes thought that their administration was simply the addition of a second poison to the one which already was overwhelming the nervous system.

In pelvic peritonitis, in the course of forty-eight hours, plastic exudation is thrown out and the pain to a great extent subsides. From this time very moderate doses of opium, as a rule, are needed to make the patient comfortable.

In France, leeches applied to the abdomen are much used as a means of relieving peritoneal sensitiveness. That they do this is beyond question. Their disuse in this country is due probably more to popular prejudice than to their inefficacy.

In the beginning of an attack a turpentine stupe to the abdomen is a source of comfort to many women, while the sharp counter-irritation exercises possibly a favorable influence upon the course of the disease. At a later period I commonly employ flannels wrung out in water and covered with oil-silk to prevent speedy evaporation. It is an old ex-

* The details of this case have been reported in the Am. Jour. of Obst., Oct., 1880, p. 864, by Dr. F. M. Welles, who conducted the administration of the opium.

perience that, in the beginning of a puerperal fever, the provocation of loose stools by purgatives is frequently followed by a fall in the temperature and a great improvement in the patient's condition. The result, however, is far from uniform, as in other cases these artificial diarrhœas have a tendency to aggravate the peritoneal symptoms. Owing to this uncertainty in their action, purgative remedies should be administered with caution, not from any theory as to their eliminative powers, but because of the ascertained existence of fecal accumulation. In pelvic inflammations, castor oil in two- or three-tablespoonful doses, or five to ten grains of calomel rubbed up with twenty grains of bicarbonate of sodium, as recommended by Barker, may be given when thus indicated. After the bowels have once been freed, however, the purgative should not be repeated. In cases of intense local inflammation and in general peritonitis, enemata should alone be employed for the removal of constipation.

Every increase of body heat is associated with rapid tissue waste, with enfeebled heart-action, and with exhaustion of the nerve-centers. Since the modern recognition of the deleterious effects of high temperatures *per se*, antipyretic remedies in place of the old-time cardiac sedatives have come to play the leading *rôle* in the treatment of fevers.

Of internal antipyretic agents, quinia enjoys a deservedly high repute. In the remitting forms of fever it may be administered in five-grain doses, at intervals of four to six hours. Given thus in medium doses, it moderates the fever, diminishes the sweating, and in most patients lessens gastric and intestinal disturbances. In continued fevers it should, on the contrary, be given in a single dose large enough to procure a distinct remission. By making a break in the febrile symptoms, if only of a few hours' duration, a retardation of the destructive processes is accomplished. At the first administration, twenty to thirty grains may be given. In favorable cases the temperature falls in the course of a few hours below 101°. When the high temperature is only temporarily held in check, at the end of twenty-four hours, if all symptoms of cinchonism have disappeared, the same dose should be repeated. If the doses mentioned, given in the manner prescribed, produce no perceptible effect upon the fever, their continuance may be regarded as unnecessary.

C. Braun and Richter speak favorably of the action of salicylate of sodium.* It possesses antipyretic properties, though in a less degree than quinia. It is, however, rapidly absorbed, circulates through all the parenchymatous organs, and finally is discharged unchanged in the urine. It is said by Binz, in small doses, to hinder the action of the disease-producing ferments, while it leaves untouched the normal ferments of the organism. It is of special service where quinia is not

* Richter, Ueber intrauterine Injectionen, etc., Zeitschr. für Geburtsk. und Gynaek., Bd. ii, Heft 1, p. 146.

well tolerated, or when given fifteen to twenty grains at a time, every four to six hours, as an adjuvant to large single doses of quinia. The remedy should be continued until all traces of febrile disturbance have disappeared.

A more powerful remedy than salicylic acid, where quinia has failed, is the Warburg's tincture. Some patients find, however, that it is somewhat difficult to retain upon the stomach.

Antipyrine, antifebrin, or phenacetin, given in conjunction with quinia, are usually efficacious in producing temporary reductions of temperature, and are in the rule well borne. Their administration, however, calls for watchfulness, and their employment should be suspended in case they are found to impair the quality and force of the pulse.

Braun recommends in severe cases, where quinia alone is without effect, to give in addition from twelve to twenty-four grains of digitalis in infusion, *per diem*, until its specific action is produced. Unlike veratrum, digitalis effects a permanent slowing of the heart. By prolonging the cardiac diastole and contracting the arterioles, it allows the left ventricle to fill, restores the arterial tension, diminishes correspondingly the intravenous pressure, and promotes absorption. Its tendency to produce gastric disturbances and the distrust felt as to its safety have prevented its becoming popular in practice.

Alcohol as an adjuvant to treatment is indicated in all cases, whether quinia or salicylic acid or veratrum be simultaneously employed. It stimulates and sustains the heart, it retards tissue-waste, and is in itself an antipyretic of no mean value. Usually I give it in conjunction with quinia, one or two teaspoonfuls hourly, of either whisky, rum, or brandy, in accordance with the recommendation of Breisky.*

The antipyretic action of drugs is probably due for the most part to some direct influence they exert upon the oxygenation of the tissues. Of course, the less the fire the less the heat. It is well, however, to support their internal administration by the external employment of cold. Cold owes its effect in fevers partly to the abstraction of heat from the body-surface, and, in a still more important degree, to the impression which it produces upon the nervous system. In healthy persons the action of cold is to increase the consumption of oxygen and the production of carbonic acid. The additional heat thus generated renders it possible to sustain the vicissitudes of climate. In fevers the primary effect of cold is similar in character. Its main therapeutical action is derived from its secondary influence upon the nerve-center which regulates the body-heat. If the cold employed be sufficiently intense or sufficiently prolonged, there follows, not always immediately, but in the course of an hour or two, a marked lowering of the temperature, which

* Ueber Alcohol und Chininbehandlung, Bern, 1875.

can only be accounted for by assuming an indirect influence exerted through the sympathetic nerve and the medulla oblongata. This peculiarity renders the external application of cold a most valuable addition to the therapeutical resources available in fevers.

In cases of moderate severity frequently sponging the patient with cold water will be found to be a grateful practice. An ice-cap to the head, where the blood lies near the surface, will often affect the entire temperature of the body. From immemorial times it has been employed to control delirium and promote sleep. An ice-bag placed over the inguinal region is locally beneficial to deep-seated pelvic inflammations, and, according to Braun, is capable of effecting a rapid fall of temperature. Ice-cold drinks should be freely allowed.

In fevers of great violence, the systematic application of cold, by means of baths or the wet pack, is capable in some cases of rendering important service. The temperature of the bath should range from 70° to 80°. Its duration should not exceed ten minutes. The patient should, when removed to the bed, be wrapped in a sheet without drying, and should be comfortably covered. In employing the wet pack two beds should be placed side by side. The body and thighs of the patient should be wrapped in a sheet wrung out in cold water, and be allowed to remain in the pack from ten to twenty minutes. As the sheet becomes heated the patient should be placed in a fresh one upon the second bed, and the transfers should be continued until the desired fall of temperature is effected. Braun claims that four packs are equivalent in action to one full bath.

In some instances it must be admitted that the full bath is followed, in spite of hot bottles to the feet and the administration of stimulants, by such a degree of depression and impairment of cardiac force, as shown by the persistent coldness of the extremities, that it has been necessary to discontinue it. On the other hand, I can look back upon cases, apparently so desperate that the condition of the patients was looked upon as hopeless, where they proved the means of saving life as by a miracle. Of course, the difference depends upon whether the high temperature is the sole cause of the alarming symptoms, or whether the latter are, in part, due to blood-dissolution and secondary changes in the parenchymatous organs.

The use of the coil in fever, whether of rubber or of metal tubing, I can highly recommend. Either the night-dress or a towel should be placed between the coil and the skin. A current of cold water passing through the tube rapidly abstracts the surface heat, and is usually grateful to the patient. The lowering of the temperature by this means is much slower than by cold affusions. Disturbance of the patient is, however, avoided, and the method, so far as I have tried it, has been free from the objections incident to the direct application of water to the skin.

It is hardly necessary to state that in puerperal, as in other fevers, the patient's strength requires to be sustained and the waste of tissue to be repaired, as far as possible, by the regulated administration of liquid food, as milk and beef-tea, in such quantities as can be borne by the stomach. Probably in the future laparotomy is destined to play a prominent *rôle* in the treatment of puerperal peritonitis. Price has reported a number of successes which recovered after early operation followed by irrigation and drainage. The favorable results are to be expected, he states, when peritonitis is the result of localized disease, as in pus collections or gangrenous conditions of the tubes and ovaries. The idea of accomplishing good by washing out the peritonæum in lymphatic peritonitis is chimerical. The peritonitis is only a single symptom of a general systemic poisoning. The obstacle to popularizing laparotomy as a resource in the treatment of puerperal fever has, so far, been the difficulty of differentiating the cases. Thus, Baldy states, "If there is pus in the tube it is easy to settle the question." "In the vast majority of cases," he adds, "in which I have been asked to decide for or against the operation, I have advised waiting, and all these cases have recovered." And again, "The great question is to decide whether pus be present or not, and it requires caution, or we shall be led into many operations which will be unnecessary." *

In the treatment of encysted peritoneal effusions, and in inflammatory exudations into the pelvic and adjacent cellular tissue, after the acute symptoms have subsided the attention should be directed to the afternoon fever and to promoting the assimilation of food. So soon as the sweating and fever are checked, the absorption of the plastic materials begins. The most important agents for accomplishing this object are quinia, in moderate doses, combined with some form of alcohol and with tepid sponging. Deep-seated pain in the iliac region is best relieved by a large blister upon the side over the point where the tenderness is felt. Prolonged rest in bed should be enjoined. Even after convalescence is well advanced, so long as the exudation remains unabsorbed, the resumption of household duties is pretty certain to be followed by a relapse or by the development of a chronic condition of a most intractable description. The sooner the patient's stomach can be got to digest and absorb beefsteak and iron, the more speedy will be her recovery.

In pelvic exudations the hot vaginal douche, warm baths, and the application of flannels wrung out in water to the abdomen aid in di-

* *Vide* Price, Early Operation in Purulent Peritonitis, Med. News, Aug., 1890, p. 143; Discussion on Dr. Geo. Shoemaker's paper on Puerperal Septicæmia before the Obst. Soc. of Philadelphia, the Am. Jour. Obst., Nov., 1889, p. 1194; Maury, The Indications for Laparotomy in the Treatment of Puerperal Fevers, Trans. of the Am. Gyn. Soc., 1891, p. 248; Hirst, The Position of Abdominal Section in the Treatment of Septic Peritonitis after Childbirth, *idem*, p. 461.

minishing the local pain, and, perhaps, in causing a disappearance of the tumor. The action of mercurials or of iodide of potassium in melting away plastic inflammatory materials is sometimes very striking, but more frequently they either do no good or else do harm by disturbing the digestion.

If fever, chills, and sweating announce the presence of pus, the most careful exploration should be made to determine, if possible, the seat of suppuration. It is of great advantage to treat pelvic abscesses as abscesses are treated elsewhere in the body. If the redness of the skin above Poupart's ligament indicates a tendency to point in that direction, an aspirator-needle should be introduced to make sure of the diagnosis. If the sac is near the surface, a free incision should be made and the pus should be allowed to escape. In many cases, I make these incisions three to four inches in length. The redness of the external skin makes it certain that the abscess has become adherent to the abdominal wall, and that the incision consequently will not communicate with the peritonæum. After the abscess has been opened it should be cleansed, and the cavity should be filled with iodoform gauze. I can recommend this plan as essentially a mild procedure. With a large opening for the discharge of pus, the fever and sweating disappear, the appetite returns, and the abscess fills rapidly by granulation. With a small incision, hectic is apt to persist, and the abscess to end in the formation of interminable fistulæ.

If softening and bagginess or distinct fluctuation indicate that the pus can be reached through the vaginal *cul-de-sac*, the aspirator-needle should be inserted deeply at the suspected point, and, if a large amount of pus is detected, an incision should be made with a long-handled bistoury, using the needle as a director, and making the opening large enough to permit thorough irrigation with a disinfectant douche, and packing of the cavity with iodoform gauze. With drainage and cleanliness, cases of the longest standing may be expected to recover.

P. F. Mundé * has reported a number of cases of chronic character where the aspiration of pus has been followed by rapid absorption of the intrapelvic exudation. The presence of pus was suspected because of a boggy, doughy feeling in the exudation tumor. In a certain number of cases, however, the patient is saved from chronic invalidism only by abdominal section and the removal of pus-containing tubes or ovaries.

* Diagnosis and Treatment of Obscure Pelvic Abscess, etc., Arch. of Med., December, 1880.

CHAPTER XXXVII.

PUERPERAL INSANITY.—PHLEGMASIA ALBA DOLENS.—DISEASES OF THE BREASTS.

The insanity of pregnancy, of childbed, of lactation.—Phlegmasia alba dolens.—Defective milk secretion.—Galactorrhœa.—Sore nipples.—Subcutaneous inflammation of the breast.—Submammary abscess.—Parenchymatous mastitis.—Galactocele.—Prophylaxis of ophthalmia neonatorum.

The Insanity of Pregnancy, Childbed, and Lactation.

When we remember the marked perturbation of the nervous system, in even normal pregnancy, from reflex causes, from disorders of the digestion, and from depravation of the blood, it is not strange that the same conditions which give rise to moral perverseness, to the loss of memory, to hysteria, or to hypochondria, should likewise prepare the way for the outbreak of the more pronounced forms of mental derangement. In character, the psychical disturbances of child-bearing women do not differ from those which develop under ordinary circumstances; but so active are the causes during the period in question that of the insane who crowd the public asylums, in one eighth, according to Tuke, the malady is of puerperal origin. In many women there exists in advance an hereditary disposition to insanity, the events of pregnancy and childbed, which are commonly associated with the ultimate attack, acting simply as the sparks which fire the mine.

During pregnancy the prevailing form of mental disturbance is melancholia, with sometimes a tendency to suicide. The prognosis is favorable when the disease develops in the early months and follows physiological depression and hypochondria; unfavorable in severe attacks occurring first in the latter half of pregnancy, or where pregnancy intervenes in the case of insanity previously existing. As a rule, these patients can be best cared for in well-regulated private institutions, where they are not subjected to the good-intentioned expostulations of intimate friends.

The pains of labor in excitable persons are said to give rise at times to a transitory delirium; but this certainly is of very rare occurrence in these days of anæsthetics. The indications for treatment are, of course, to relieve the pain and to hasten the birth of the child.

Mania may occur in any severe puerperal affection. It has been observed not only in the various forms of metritis, but even, according to Winckel, as a result of sore nipples and very painful inflammations of the breasts. The delirium in these cases rises and falls with the fluctuations in the underlying malady, and is thought to be dependent upon associated cerebral hyperæmia. The maniacal manifestations may consist, when there is freedom from suffering, of agree-

able hallucinations—the patient often singing or wearing on her face a rapt expression; or, if the pain is great, she may, on the other hand, see forms which threaten her, so that in terror she cries for help, springs from bed, and strips off her clothes in the effort to escape the source of danger. The prognosis depends, of course, upon the gravity of the morbid condition, of which the mania is only a symptom. The treatment, with the exception of dry cold to the head, is that of the main affection.

Again, puerperal mania may proceed from an hereditary predisposition or from diseases antedating pregnancy, in either case the puerperal state acting as the proximate but not as the fundamental cause of the outbreak. The attacks may be accompanied by erotomania, by nymphomania, by religious anxiety, or by the *délire de persécution*. It may be evoked by psychical impressions. It occurs at an early period of childbed, when the strength is wasted by pain, excitement, or fever.

Finally, puerperal mania may be caused by exhausting losses of blood, by intense pain, by eclampsia, or by anything which occasions cerebral congestion. In this, the so-called idiopathic form of puerperal mania, the attack is generally preceded by sleeplessness, indistinctness of speech, by restless movements, and the refusal to take food. At the beginning of the attack the delirium is usually of a noisy character, the patients screaming, praying, or preaching in a declamatory fashion; or they try to get out of bed and to escape from the room by the doors or windows. Sexual excitement is rare, the disposition to strip off the night-dress and expose the person proceeding not from an erotic impulse, but from a desire to escape from some fancied restraint. Attempts to control these patients by force are apt to excite them to renewed violence. This acute stage is followed by melancholia, characterized by weeping, praying, and fears concerning the commission of the unpardonable sin. As a result of the mental depression, suicidal tendencies develop in a considerable proportion of the cases. The period at which the outbreak first attracts notice occurs most frequently within the first two weeks.

The indications for treatment are to check profuse, exhausting discharges, to support the patient's strength, and to insure perfect quiet. With the first sign of trouble, the child should be taken from the breast, liquid food should be given at frequent intervals, care should be taken to keep the bladder and the rectum empty, the room should be darkened, and its temperature should be regulated. The activity of the skin should be promoted by means of the sponge-bath. The sacrum should be watched and strapped with adhesive plaster if bed-sores threaten. Furniture, pictures, or any articles which disturb the patient should be removed from her sight. There is no condition in which trained nursing can do so much toward effecting recovery. The

nurse's duties are to administer food, to see that urination is regularly performed, to keep the patient covered, and to prevent her from doing harm to herself or others. Members of the household who can not resist the impulse to show the insane woman the folly of her delusions should be regarded as disqualified from entering the sick-room. Pastoral visits are rarely beneficial. If the patient becomes violent, it is usually possible for the family physician to obtain obedience without the exercise of restraint or force. So important is the question of personal influence in the management of puerperal insanity that the success of home treatment is almost wholly dependent upon the control which the physician has acquired over the *morale* of his patient previous to the occurrence of her malady. Narcotics do not cure, but when they produce a few hours' sleep they certainly promote recovery. There is hardly one in the entire list which has not, at some time, done me good service. My preference is for chloral and the bromide of potassium (āā gr. xxx) in solution, and administered by the rectum. To procure an effect from moderate doses, it is, however, necessary that the narcotic be given, not during the period when the patient is most voluble and restless, but either after she has become quieted by judicious management or during a natural interval of calm. Cold to the head is often very effective in relieving headache and cerebral congestion. If the stage of exaltation passes into that of melancholia, the question of continued home-treatment becomes a serious one. The mother sometimes exhibits not only indifference, but even a positive dislike, to her child, which makes it a risky thing to leave them alone together. Again, owing to the suicidal tendencies which often go with melancholia, it never is safe to allow the patient to pass out of observation, as is shown by the following case: A young woman, after her first confinement, had an attack of mania, for which she was sent to a private asylum. Shortly after, she was removed by her friends to her own home. There her sweetness and passive resignation disarmed suspicion. One day, however, she dropped her sewing, put on her hat, and, bidding her mother a pleasant good-by, walked quietly down to the river—a half-mile away—and composedly lay down in the shallow stream, near the bank, so that the water covered her face. From this position she was rescued by some men who were mowing in a field near by, and by them was carried insensible to her home. The next day she was returned to the asylum, where she soon made a good recovery.

The insanity of lactation is either the result of cerebral anæmia or a relapse from a previous attack. It begins, as a rule, six to ten weeks after confinement. In most cases it assumes the form of melancholia. The prognosis is good if the disease is treated in season, by stopping lactation and by removing the debility upon which it depends.

In general, the prognosis of puerperal mania is favorable, more than sixty per cent. of the cases ending in recovery. In private practice the

number is probably much larger. During convalescence care should be taken to secure to the patient rest, sleep, nutritious food, and a daily evacuation of the bowels, and little by little she should be brought back, once more, to old habits and the responsibilities of existence.

Phlegmasia Alba Dolens.

Phlegmasia alba dolens is the term applied to a swelling of one or both lower extremities, occurring usually between the tenth and twentieth day after confinement, and characterized by pain, tension of the skin, and a milk-like whiteness of the surface. Owing to its color and its supposed origin, it has received the popular name of *milk-leg*. Phlegmasia is an affection of the connective tissue, and is associated in most, but not in all, cases with thrombosis of the veins.

The origin of the swelling is somewhat obscure. In a certain proportion of cases phlegmasia is obviously the extension of an inflammatory process from the genital organs to the perinæum, the nates, and the upper portion of the thigh. If confined to the subcutaneous and intermuscular cellular tissue, the vessels may not become affected. When, however, the morbid changes follow the sheaths of the vessels, the walls of both veins and lymphatics thicken, and in most cases secondary thrombus formation results.

In other instances, the thrombus formation is apparently the primary lesion. It may occur spontaneously from slowing of the blood-current. A predisposition to thrombosis is created by varicose veins. The vessels usually involved are the crural and its branches, the tibial and peroneal veins. Again, the intravenous coagula may start from the placental site, and, extending along the pampiniform plexus to the hypogastric vein, may thence occlude the crural to Poupart's ligament, or, passing upward by the spermatic veins, they may obstruct the vena cava. Sometimes the occlusion of one crural vein is succeeded by that of the other, phlegmasia in that case developing in both extremities.

Thrombus formation may begin during pregnancy, and is then usually attended with pain at the seat of trouble, and with stiffness in the toes or the dorsum of the foot. As a rule, however, the disease is rare before the second week following labor. Often it is preceded by gastric disturbances, as lack of appetite, a furred tongue, and constipation, by chilly sensations, and by a heavy feeling in the affected limb. A careful examination sometimes reveals the existence of inflamed or thrombosed veins in the leg, in the popliteal space, or upon the inner surface of the upper portion of the thigh. If the affected veins are superficial, the redness and swelling may be obvious to the eye.

The first characteristic symptom is the development in the limb of a dull, dragging pain, which is increased by motion. Tenderness to pressure is only experienced along the course of inflamed vessels.

In primary thrombosis, the swelling usually begins at the ankle,

and spreads rapidly to the knee and upward to the inguinal region; in secondary thrombosis, extending from the uterine sinuses, and in the superficial form of phlegmasia, the swelling, on the contrary, travels commonly in the reverse direction, viz., from the inguinal fold to the ankle.

The onset may or may not be announced by a chill. Fever often precedes and accompanies the attack. It is, however, in uncomplicated cases, of a mild type, and sinks to the normal point long before the swelling of the limb subsides. Severe chills and intense fever, with marked remissions, are symptomatic of metastatic pyæmia. Other complications may essentially modify the course of the disease. The pain, the tenderness, and the febrile disturbance are usually greatest in the phlegmonous form of swelling, which starts from the genital organs.

The ordinary termination of phlegmasia is by absorption of the thrombus, with restoration of the circulation. As this takes place, the tension of the skin subsides and the parts pit upon pressure, as in ordinary œdema. As the swelling and pain subside, the mobility of the limb becomes restored. The period of extreme tension lasts, as a rule, for from five to eight days. Recovery takes place slowly, the dispersion of the tumor requiring from three to six weeks.

A less common result consists in the permanent obliteration of the vessel by the conversion of the thrombus into a solid connective-tissue cord, in which case the extremity may long continue heavy, and locomotion be attended with difficulty.

In rare instances the process may terminate in suppuration and abscess formation. The prognosis of a pus collection in the vicinity of a vessel, resulting from periphlebitis, is usually favorable, the symptoms that it occasions disappearing when the abscess is opened and the pus is allowed to escape. When the suppurative process is of a spreading character, undermining the skin and attacking the intermuscular cellular tissue, the destructive changes may assume frightful proportions. Thus, in hospital practice, we sometimes witness cases where the muscles are dissected from one another, and are bathed in an ichorous fluid, with greenish particles of necrosed tissue adhering to them, death ensuing from intense septicæmia.

Sometimes a thrombus becomes infected and undergoes puriform softening, with detachment of small particles, which, entering the circulation, give rise to infarctions and metastatic abscesses; or a large fragment may be separated accidentally from a normal clot, and, passing by the vena cava and the right side of the heart, may cause sudden death by plugging the pulmonary artery.

The prognosis, from what has been said, is evidently dependent upon the origin of the phlegmasia and upon the nature of the complications. The principal indications for treatment are, opium to al-

leviate pain, cathartics, if needed, to unload the bowels, quinine, iron, and good food to sustain the strength, and rest for the swollen extremity. The latter should be raised somewhat higher than the body, and during the early stages of the swelling should be wrapped, as recommended by Dr. Fordyce Barker, in cotton-batting and oil-silk. The tenderness should be mitigated by the application of soothing liniments. If vesicles form upon the surface, they should be punctured and the fluid be allowed to escape. When the extremity begins to pit on pressure and the tenderness to subside, absorption should be promoted by gentle frictions with alcoholic lotions and by bandaging the entire limb evenly with a flannel roller. Until every trace of tenderness and thickening has disappeared from the veins the patient should under no circumstances be allowed to leave her bed. The danger of death from sudden obstruction of the pulmonary artery is always present until the thrombus has disappeared or become firmly organized.

For some time after recovery has taken place the limb will swell, as the result of standing or of protracted exercise, a condition which, as a rule, is greatly benefited by the patient wearing a long elastic stocking.

Diseases of the Breast.

Defective Milk-secretion.—A scanty milk-secretion, due to lack of mammary development, to extreme youth, to polysarcia, or to the mature age of the mother, is not amenable to treatment. Temporary insufficiency, resulting from defective nutrition, may sometimes be remedied by a regulated nitrogenized diet, by the tincture of iron, an outdoor life, and by the consumption of large quantities of fluid. A diet composed for the most part of milk is strongly to be recommended. If the baby is feeble, and sleeps or cries when put to the breast, it is a good plan for the mother to borrow, for a time, a healthy infant with strong suction powers to stimulate the glands to perform their functions. Cataplasms of castor-oil leaves or fennel-teas possess no claims to confidence.

Galactorrhœa.—An abundance of milk is not pathological, the quantity quickly accommodating itself to the wants of the child. A constant dribbling of milk from the nipple, or *galactorrhœa*, an affection which may continue long after lactation has been suspended, acts, like any other profuse discharge, in exhausting the strength and in producing a wasting of the tissues. The treatment consists in interrupting lactation, in compression of the breasts, and in the employment of such dietetic measures as are best calculated to repair the general health; of special measures, saline laxatives and the internal administration of iodide of potassium are of most repute.

Sore Nipples.—Under the term *sore nipples* are included a number of lesions which, in spite of their seeming triviality, possess considerable importance, not only on account of the suffering they occasion,

but because they furnish the starting-point of most cases of mammary abscess.

A simple erythema, associated with great tenderness, is a common trouble at the beginning of lactation, to which, however, primiparæ are more subject than multiparæ. It is a good plan to anticipate this difficulty by instructing the patient to wash the nipples daily, during the last weeks of pregnancy, with some astringent or alcoholic solution. In childbed, in addition to strict cleanliness, great benefit is derived from folding a linen rag around the nipple and keeping it constantly wetted with Goulard's extract, a teaspoonful to a tumbler of water, until the sensitiveness and redness have disappeared. Before applying the child to the breast, care should be taken to wash away the deposited carbonate of lead.

In many women, owing to the maceration and loosening of the epithelium from the oozing of the colostrum, suckling of the child is followed by the formation of small vesicles, which eventually rupture and produce isolated erosions. Under favorable conditions, these erosions become covered with crusts beneath which the healing process takes place. If, however, the crusts are removed by suckling before a new layer of epithelium has had time to form, the simple excoriation may be converted into an ulceration with deep destruction of tissue. If the child be suffering from sprue, the transfer of the oïdium albicans may impart to the wounds of the nipple an aphthous character. If the primary vesicles, in place of remaining isolated, coalesce, the nipple may become bared of its epithelium over a considerable extent of its surface. The papillæ then enlarge and give a raspberry-like appearance to the exposed structure.

Fissures of the nipples are excruciatingly painful, and are capable of exciting even a high degree of fever. They occur with greatest frequency in nipples which have been flattened by the pressure of corsets, or in which the natural fissures between the papillæ are of unusual depth. Most commonly they are seated at the base of the organ. Either they may develop from the erosions just described, or the clefts upon the surface may become covered by crusts composed of dirt and colostrum, which, when torn away by the nursing child, detach the delicate underlying epithelium.

As regards the treatment, it is well to bear in mind that, with cleanliness and the removal of irritating matters from the wounded surface, the worst cases of sore nipples will get well in from twenty-four to forty-eight hours, provided lactation is suspended. The object of treatment, therefore, is to cure the lesion without interfering with the nursing of the child. This is comparatively easy when but one nipple is affected, as the child need only be applied to the sound side. In that case, however, the excessive tension which results from the suspension of lactation should be relieved by stroking the breast from

the base toward the apex with the hands, or by getting the nurse to draw the milk with her mouth, or by means of a breast-pump with a wide, trumpet-shaped extremity. The healing process can at the same time be promoted by lead-lotions, by a solution of tannin, or by some astringent ointment. My rule is to keep upon the nipple a rag wetted with the Goulard's extract, as described for erythema, during the patient's waking hours, substituting therefor a carbolized ointment during the hours of sleep, when the drying of a lotion would cause the rag to adhere to the raw surface. If the child be troubled with sprue, special attention must be taken to cure its mouth, and the development of the oïdium albicans upon the nipple should be prevented by frequent washings with solutions of boracic acid or of the sulphite of sodium.

Cracks are much more rebellious to treatment than simple erosions. If of any extent, the nipple should be drawn to one side, so as to expose the fissure, which should be touched with the point of the mitigated stick of nitrate of silver. As the effect of the latter is intended to be local, it should be applied dry, the lymph furnished by the denuded surface affording the requisite moisture. I mention this trivial detail, as, in hospital practice, I have sometimes seen the entire nipple robbed of its epithelium, owing to the mistake made by the house-physician of first dipping the pencil in water, and then allowing the strong solution to diffuse itself over the sensitive surface. The compound tincture of benzoin, strongly recommended by Professor Fordyce Barker, makes a good stimulating application to cracks of the nipple. Though somewhat painful, when used for the first time, it is afterward easily tolerated.

If both nipples are simultaneously affected, lactation can not of course be entirely interrupted without drying up the milk, but the intervals between the acts of nursing should be lengthened as much as the comfort of the mother will permit. If the milk will not come without tugging, the flow should be furthered, before applying the child, by stroking the breasts. Of nipple shields I am not able to speak with much enthusiasm. Many, if not most, infants resent the ordinary rubber ones, and refuse to suck through them. A more acceptable form is one provided with a rubber tube and mouth-piece such as commonly goes with nursing-bottles, but it is apt to drive away the milk if its use is long persisted in. Legroux recommends a bit of gold-beater's skin, fastened to the breast by means of collodion, and perforated with a needle over the portion which covers the openings of the lactiferous ducts. But, even without these aids, in time a cure can usually be effected by perseverance in the use of the remedies already mentioned. It is necessary to stop nursing altogether only when the nipples are hopelessly flat and misshapen, or when mastitis threatens.

For eczema, lead, zinc, or white-precipitate ointment may be employed. In obstinate cases, a solution of corrosive sublimate (gr. v ad ℥ j) is recommended by Hebra.

Subcutaneous Inflammation of the Breasts.—The subcutaneous inflammation may be confined to the areola, which then becomes red, swollen, and excessively sensitive. This form generally terminates in suppuration, and may form fistulous communications with the lactiferous ducts. Sometimes the inflammation begins in the sebaceous follicles, giving rise to small boils around the nipple.

In other cases inflammation may extend beyond the areola, and either give rise to localized abscesses, or, when due to the septic infection of excoriated nipples, assume an erysipelatous character.

The treatment of both these forms consists in the application of warm lead-lotions, and in the early evacuation of the pus. To avoid cutting into the milk-ducts, the incision should radiate from the nipple.

Inflammation of the Submammary Connective Tissue.—This rare condition owes its origin, according to Billroth, in most, if not in all, cases to abscess formation in the deep-lying glandular structures, the pus perforating the fascia-like connective tissue at the base of the organ into the loose connective tissue situated between the gland and the pectoral muscle. The breast is in consequence lifted from the trunk, and can be moved to and fro, as though it rested upon a water-bed. The skin is not reddened, but is sometimes markedly œdematous. The pain is deep-seated and dull; the fever is high and continuous; the axillary glands swell, and movements of the arm are hindered by the increase of the pain they occasion. Stoltz is said to have removed from such a sac twenty ounces of pus. So soon as the pus formation is recognized, and the fact can be early determined by means of an aspirator-needle, a free incision should be made at the lower portion of the gland, and the wound should be treated with the antiseptic precautions which will be given in connection with parenchymatous mastitis.

Parenchymatous Mastitis.—Inflammation of the glandular structures of the breast develops usually in the first four weeks after confinement. It is characterized by pain, high fever, and nodular enlargement of the affected lobules. The attack usually begins with a sharp chill. These symptoms are sometimes observed three to four days after the birth of the child, at the beginning of lactation, but then are usually temporary, the commencing mastitis terminating in spontaneous resolution. Mastitis leading to abscess-formation belongs, for the most part, to a later period, occurring most frequently in the third or fourth week, long after the first inflammatory symptoms have subsided.

Puerperal mastitis is quite commonly believed to be due to emotional causes, to cold, to blows, or to "caking" from milk retention

—all suppositions of extreme convenience as relieving the physician from responsibility for their occurrence. They certainly, however, play a subordinate *rôle* in the etiology of the affection, the lesions of the nipples furnishing, with perhaps rare exceptions, the starting-point from which the inflammation travels to the glands, either passing to the deep-seated tissues by the lymphatics, or following the track of the lactiferous ducts to the glandular acini.* The exact anatomical structure of the resulting nodular masses is, for the most part, matter of conjecture. Only this much is known certainly, that they are composed in part of glandular structures and in part of the swollen interstitial tissue; that the lactiferous ducts are either constricted or closed; that suppuration takes place both in the connective tissue and in the acini; and that the large abscess-cavities form from the coalescence of small pus-collections. The walls of the abscess are, therefore, never smooth, but are uneven, with projecting portions of glandular tissue which has, as yet, not undergone disintegration. The milk-secretion is arrested in the affected lobules. If, as sometimes happens, a large duct is perforated, pus may be discharged with the milk, or, in case the abscess opens externally, a milk-fistula may be produced. When several foci of inflammation exist, they may suppurate in succession, so that abscess after abscess may develop, and the morbid condition be protracted for weeks, and even months. If the abscesses break spontaneously, at a point unfavorable for the discharge of pus, fistulous passages are liable to be produced. In hospitals, as the result of long-continued suppuration and necrosis of tissue, entire lobes may undergo destruction, with subsequent cicatricial formation and ensuing deformity of the breast; or, with the access of unwholesome air to the abscess-cavities, the sloughing tissues may become gangrenous and death may follow from septicæmia.

The first important point as regards the treatment of parenchymatous mastitis is to take the child from the breast. If this is done early, in a very large number of cases the inflammation will disappear without advancing to suppuration. If lactation is continued, especially when sore nipples persist as a complication, the chances of avoiding abscess-formation are extremely small. In cases of pain due to excessive fullness of the milk-ducts, partial relief should be given by means of mammary expression. For the pain, opium, for the fever, a full dose of quinine, should be administered. A saline cathartic acts as a derivative and diminishes the hyperæmia of the breasts. As the

* Baum (Zur Aetiologie der puerperalen Mastitis, Arch. f. Gynaek., vol. xxiv, p. 262) discovered diplococci in the pus obtained from a mammary abscess. These diplococci were subjected to pure culture, and in the fifth generation were inoculated, by means of a hypodermic syringe, into his own skin and into that of two other persons. The inoculations were followed by hardening, fever, suppuration, and the formation of sinuous cavities.

pain of the inflammation is augmented by the weight of the organ, the breast should be raised and supported by a suitable bandage. Much comfort is often afforded by the local application of belladonna, in the form either of an ointment or of the liniment diluted with three or four parts of opodeldoc. Considerable relief is likewise obtained by laying a flannel wetted with a lead-and-opium wash over the breast, and placing on the outside some water-proof substance to prevent speedy evaporation. A large flaxseed-poultice lessens pain by reason of its heat, but should not be employed, at least so long as the hope of absorption has not been abandoned. Indeed, previous to suppuration, dry cold (ice-bag), which is both sedative and antiphlogistic, deserves the preference.*

So soon as there are evidences of pus, such as bogginess, œdema, or reddening of the skin, the abscess should be opened with antiseptic precautions. If the inflamed acini are situated near the surface, fluctuation is early apparent. In deep-seated abscesses, the precise situation of the pus collections is not easy to determine. If the matter is doubtful, it is better to first insert an aspirator-needle into the breast rather than to subject the woman to a painful operation, which, if misdirected, may require to be repeated.

In Billroth's clinic † the following plan is adopted in opening abscesses of the breast: The surface should first be cleansed with soap and drenched with a solution of carbolic acid or of thymol. The incision should be a half-inch in length, and should radiate from the nipple. A drainage-tube should be instantly introduced, and the pus should be gently expressed, after which the breast should once more be bathed with a disinfectant fluid. The entire breast should then be enveloped in antiseptic gauze covered with water-proof material. Finally, after packing the periphery with oakum, especially beneath the breast and in the axilla, the dressing should be fastened with a bandage extending over the thorax from the neck to the umbilicus. In doing this, care should be taken to pack sufficient cotton beneath and around the sound breast to prevent its surface being pressed into contact with that of the thorax. If the abscess is large and sinuous, the dressing should be changed in twenty-four hours, and then should be left in place for from three to five days. By these means the organ is equably compressed, the pus is prevented from decomposing, and the discharge is promoted, all conditions which tend to produce a painless course and a rapid recovery. If, while the bandage is applied, the patient once more suffers from pain and fever, it should be removed, and any new abscess in the process of formation should be opened and treated in the same manner.

* *Vide* Corsen, The Treatment of Mammary Abscess, Am. Jour. Obst., January, 1881, for account of favorable experiences.

† Billroth, Handbuch der Frauenkrankheiten, zehnter Abschnitt, p. 23.

By the practice recommended, even in bad cases, the ugly scars and deformities of the breast, which sometimes follow the older poultice treatment, are avoided.

In fresh cases, the pus is never decomposed, and irrigation of the wound is unnecessary. In old cases, on the contrary, which have been treated by small incisions and without antiseptic precautions, the pus is often acid, and possessed of irritating properties. For these neglected abscesses I can enthusiastically recommend the method of Billroth, which consists in placing the patient under an anæsthetic, enlarging the openings so as to permit the passage of the finger, and breaking down the thin partitions between the abscesses, so as to convert them as far as possible into large communicating cavities; while this process is going on, the tube of an irrigator should be passed by the side of the finger, and the cavity should be washed with a 3-per-cent solution of carbolic acid until, at last, the fluid comes away clear and unstained. Drainage-tubes should then be introduced, and the breast treated in the antiseptic manner already described. By this plan I have succeeded in closing up sinuses of long standing in the course of two to three weeks.

It is hardly necessary to add that the recovery of the patient is always aided by good food and an abundance of fresh, pure air.

Galactocele.—In very rare cases, owing to the obliteration or stoppage of one of the milk-ducts, the sinus may become distended with milk, and form a cyst termed a galactocele. Usually it is of small size, but in the often-quoted case of Scarpa the breast attained such dimensions as to reach to the thigh. Upon puncturing the tumor with a trocar, ten pounds of milk were removed, which in all respects resembled human milk of normal quality.

The Prophylaxis of Ophthalmia Neonatorum.—In 1881 Crédé * recommended that, in lying-in asylums, as a preventive measure, the eyes of all children immediately after birth should be washed with pure water, and that, thereafter, a single drop of a 2-per-cent solution of nitrate of silver should be dropped between the parted lids by means of a glass rod. This plan has since been tested in the principal maternities of Europe with the most satisfactory results. It possesses no apparent drawbacks. In exceptional instances, swelling of the lids, injection of the conjunctiva, and a hypersecretion of mucus or serum have been observed, but the reaction has been trivial, and has disappeared in from twenty-four to forty-eight hours.

* Crédé, Die Verhütung der Augen-Entzündung der Neugeborenen, Arch. f. Gynaek, vol. xvii, p. 50, and vol. xviii, p. 367.

INDEX.

Abdomen:
appearance of, in pregnancy, 86, 94, 99, 100, 105, 278.
discoloration of, in pregnancy, 100.
fat, in wall of, obscuring pregnancy, 102.
fetal, enlarged, obstructing labor, 554.
ice to, in *post-partum* hæmorrhage, 588.
in anteversion and anteflexion, 278.
injuries of, producing abortion, 308.
in puerperal state, 249.
inspection of, in pregnancy, 100.
pain in, during pregnancy, 87.
palpation of, in pregnancy, 100.
pendulous, in contracted pelvis, 467, 480.
in double uterus, 278.
size of, in pregnancy, 94, 111.
skin of, in pregnancy, 87, 100, 105.
striæ upon, in pregnancy, 87, 100, 105.
Abdominal muscles, action of, in labor, 129.
Abdominal plates, 49.
Abdominal pregnancy, 42, 327, 335, 339.
varieties of, 336.
Abdominal tumors:
diagnosis of, from pregnancy, 102, 549.
Abortion (*vide* labor, premature), 307.
alcohol in, 323.
anæmia, causing, 308, 351.
anæsthesia in, 322.
arrest of threatened, 318.
artificial, 359.
indications for, 359.
bougies to produce, 351.
carbolic acid in, 323, 324, 325.
care of child after, 356.
catheterization to produce, 351, 356.
causes, immediate, of, 310.
anteflexion, 310.
hyperæmia of gravid uterus, 310.
infectious diseases, 260 *et seq.*, 308.
uterine contractions, from nervous influences, 311.
causes, predisposing, of, 113, 308.
atrophy of uterine mucous membrane, 309.
Abortion:
hypertrophy of uterine mucous membrane, 310.
cellulitis in, 325.
chill in, 325.
chloroform in, 322.
cold in, 318, 321.
collapse in, 323.
complete, 319 *et seq.*
cord, care of, in, 326.
corpulence causing, 308.
Credé's method in, 324.
curette in, 317, 320, 324, 326.
death of fœtus causing, 308.
definition of, 307.
diagnosis of, 314.
disposition to, 308.
douche in, 320, 322, 323, 324, 325, 326, 356.
emesis causing, 118, 351, 359.
ergot, use of, in, 320, 321, 323, 461.
ether, use of, in, 322.
exercise, violent, causing, 113.
expulsion of placenta in, 324.
famine causing, 308.
hæmorrhage in, 309, 311, 312, 313, 319, 325, 326, 359.
in anæmia, 115.
in cancer of cervix, 310, 547.
in cardiac diseases, 268, 351.
in cholera, 264.
in chorea, 275, 351.
incomplete, results of, 312, 319, 320.
in contracted pelvis, 494, 497, 498, 500.
in decidual diseases, 308.
indications for, 349, 494, 497, 500.
diseases which imperil life of mother, 351.
habitual death of fœtus, 350.
moderate pelvic contraction, 349, 359, 494, 497.
in double uterus, 278.
induction of, 349.
in eclampsia, 578, 581.

Abortion:
in emesis of pregnancy, 119 *et seq.*
in emphysema, 270.
in empyema, 270.
in endometritis, 285, 286, 287.
in heart diseases, 268.
in hydatidiform mole, 301.
in hydramnion, 124, 292.
in icterus, 266.
in malarial fever, 264.
in measles, 261.
in multiple pregnancy, 124.
in nephritis, 273.
in ovarian tumors, 549.
in pernicious anæmia, 115.
in phthisis, 270.
in placenta prævia, 597, 600.
in placentitis, 289, 304.
in pneumonia, 269, 359.
in prolapse of uterus, 282.
in relapsing fever, 264.
in retention of dead fœtus, 307.
in retroflexion, 279, 280, 310, 316.
in rubeola, 261.
in surgical operations, 276.
in syphilis, 272, 350.
in typhoid fever, 264.
in typhus fever, 264.
in uterine hernia, 283.
in uterine tumors, 542, 544, 547.
in variola, 261.
in vomiting, 119, 351, 359.
lochia in, 320, 325.
membranes, retention of, in, 312, 325.
methods for producing, 351, 360.
mole, due to, 312.
mortality from, 315.
neglected, treatment of, 325.
operations for induction of, 351, 360.
catheterization of uterus, 351.
choice of, 356.
death from, 355.
douche, vaginal, 354.
galvanization, 355.
injections between uterus and ovum, 352.
mechanical dilatation of cervix, 353, 360.
rupture of membranes, 353.
tampon, vaginal, 355.
opiates in, 315, 323.
ovum-forceps, use of, in, 324.
pain in, 311.
pelvic cellulitis, complicating, 325.
peritonitis, complicating, 313, 325, 355.
placental detachment in, 325.
polypi, fibrous, removal of, after, 313, 326.
prognosis in, 315.
prophylaxis of, 316.
recurrent, 317.
retention of membranes in, 312, 313, 325.
Abortion:
rupture of uterus in, 353.
septicæmia, complicating, 313, 325.
shock, in artificial, 353.
sponge-tents in, 324, 353, 360.
stimulants in, 323.
subinvolution after, 314.
symptoms of, 311, 319.
tampon, vaginal, use of, in, 320, 322, 323, 324, 326.
tents in, 324, 353, 360.
threatened, arrest of, 318.
time for, 349, 360.
treatment of, 316.
of threatened, 318.
prophylactic, 316.
when inevitable, 319.
when neglected, 325.
tubal, 339.
version in, 356.
viburnum prunifolium in, 317, 318.
violence causing, 308.
with monsters, 557.
Abscesses:
in mastitis, 709.
in phlegmasia alba dolens, 705.
in puerperal fever, 660, 661, 674, 677, 680, 700.
pelvic, aspiration in, 700.
psoas, in puerperal fever, 677.
Acardia, in multiple pregnancy, 229.
Acardiacus, 557.
Accidental hæmorrhage, 594, 597, 606.
treatment of, 607.
Accouchement forcé, in placenta prævia, 602, 652.
Accoucheur, armamentarium of, 206.
Acephalus, 558.
Acid, muriatic, in nausea, 117.
Aconite, in face-ache, 122.
Acormus, 559.
Adipocere, 304, 306.
Æquabiliter juxto-minor pelvis, 465, 471, 485, 495, 512.
After-coming head:
forceps to, 399.
in contracted pelvis, 487.
perforation of, 418.
After-pains, 224, 244, 252, 672.
Air, collapse and death from entry of, into uterine vessels, 355, 647.
fresh, in pregnancy, 112.
Air-passages, catheterization of, in *asphyxia neonatorum*, 644.
development of, 48, 64.
Albumen, of blood, in pregnancy, 89, 115.
Albuminuria:
in eclampsia, 567, 569 *et seq.*
in hydramnion, 292.

Albuminuria:
in pregnancy, 91, 118, 262, 268, 273, 275, 307.
in septicæmia, 680.
treatment of, 577.
Alcohol, use of, in abortion, 323.
in puerperal fever, 697.
Alimentation, rectal:
in anæmia, 114.
in emesis, 119.
Alkalies, in albuminuria, 577.
Allantois, 51, 52, 61, 63.
Amaurosis, in eclampsia, 567.
in pregnancy, 91.
Amblyopia, in eclampsia, 567, 569.
in pregnancy, 91.
Amenorrhœa of pregnancy, 92, 93.
Ammonia, intravenous injection of, in cerebral anæmia, 590.
in heart-burn, 121.
in pneumonia, 270.
in pulmonary embolism, 650.
Amnion, 47, 50, 60, 61, 63, 64, 123.
anomalies of, 290.
causing *inertia uteri*, 455.
dropsy of, 75, 95, 103, 124, 290, 561.
fluid of, 61.
Amniotic fluid, 61.
anomalies of, 290.
composition of, 61.
deficiency of, 293.
escape of, 132, 312, 320.
obscuring pregnancy, 95.
Amorphus, 552.
Ampulla, of Fallopian tube, 19.
Amputation, spontaneous intra-uterine, 296.
Anæmia:
alimentation, rectal, in, 114.
causing abortion, 308.
causing insanity, 703.
cerebral, causing eclampsia, 574, 575.
ether, use of, in, 590.
hypodermic injection of ammonia in, 590.
transfusion in, 590.
treatment of, 589.
in abortion, 323.
indicating abortion, 351.
in extra-uterine pregnancy, 338.
in labor and childbed, 645.
in *placenta prævia*, 598.
in *post-partum* hæmorrhage, 589.
in pregnancy, 114, 122.
in thrombus of vagina and vulva, 625.
pernicious, in pregnancy, 114.
treatment of, 114.
Anæsthetics:
in abortion, 322.
in breech and foot presentations, 383, 387.
in brow presentations, 196.
in Cæsarean section, 439.
Anæsthetics:
in craniotomy, 414.
in diagnosis of pregnancy, 102, 341.
in eclampsia, 579.
in forceps deliveries, 367.
in *inversio uteri*, 698.
in irregular pains of first stage of labor, 457.
in midwifery, 225.
in normal labor, 210, 225, 268.
in painful labor, 463, 502.
in precipitate labor, 453.
in Thomas's operation, 449.
in version, 404, 406, 410.
post-partum, 623.
Anæsthesia, in pregnancy, 91, 102, 281.
in retroflexion, 281.
Anasarca, fetal, causing dystocia, 555.
Anchylosis of fetal joints, causing dystocia, 556.
Anencephalus, 559.
Anodynes:
in eclampsia, 579.
in emesis of pregnancy, 117, 119.
in lacerations of perinæum, 624.
in mania, 703.
in neuralgia, 122.
in painful first stage, 463.
in *post-partum* hæmorrhage, 585.
in precipitate labor, 453.
in protracted first stage, 456.
in puerperal fever, 464, 695.
in puerperal state, 252, 705.
in shock, 650.
in vaginal thrombus, 628.
Anorexia, in pregnancy, 114.
post-partum, 248.
Anteflexion, in pregnancy, 116, 278, 310.
in the puerperal state, 244, 249, 592.
Anteversion in pregnancy, 80, 278.
normal, 16.
Antipyretic treatment of puerperal fever, 696, 697.
by quinia, 696.
by salicylate of soda, 696.
in scarlatina, 263.
Antipyrine, in puerperal fever, 697.
Antiseptic treatment, of puerperal patients, 253, 687 *et seq.*
Antiseptics in Cæsarean section, 439, 441.
Anus:
development of, 63.
imperforate, 256, 296.
laceration of sphincter of, 623.
Aorta, compression of, in *post partum* hæmorrhage, 24, 588.
Apnœa of fœtus, 635, 636, 638.
Apoplexy, utero-placental, 288.
Appetite in pregnancy, 114.
after delivery, 240.

Apron, Hottentot, 4.
Arbor vitæ uterina, 13, 31.
  development of, 31.
Area, germinativa, 47, 50.
  embryonic, 47, 48, 62.
Areola, mammæ, 88, 90, 94, 89.
  follicles, sebaceous, of, 88.
  in the puerperal state, 249.
  of pregnancy, 88, 90, 94, 99, 249.
  secondary, of Montgomery, 88, 94, 99.
Armamentarium of *accoucheur*, 206.
  for breech presentations, 384, 388.
  for Cæsarean section, 439.
  for lacerations, 624.
  for *post-partum* hæmorrhage, 585.
Arms:
  liberation of, in breech presentations, 394.
    when extended, 394.
    when flexed, 394.
  release of anterior, 394.
  release of posterior, 394.
  setting of fractured, 395.
Arteria aortica, 24.
Arteria uterina, hypogastrica, 23.
  in pregnancy, 98.
  uterine bruit in, 96, 98, 100, 103.
Arteries:
  aorta, 68.
  internal spermatic, 25.
  ovarian, 25.
  pulmonary, 68.
  thrill in, in pregnancy, 100.
  umbilical, 53, 60, 66, 250.
  uterine, 23, 24, 59, 77, 79, 103.
  vaginal, 10.
Articulations:
  anchylosis of fetal, obstructing labor, 556.
  of fetal head with spinal column, 171.
  pelvic, 145, 275.
  pelvic, mobility of, in labor, 148, 275.
  rupture of, 628.
  sacro-iliac, 145.
Artificial feeding of infants, 257.
Artificial respiration, in *asphyxia neonatorum*, 643.
  Schultze's method of, 643.
  Sylvester's method of, 644.
Ascites, fetal, obstructing labor, 554.
  indicating abortion, 351.
  in ovarian tumors, 549.
  mistaken for pregnancy, 102.
  obscuring pregnancy, 102, 268, 292.
Aseptic dressing, after labor, 225.
Asphyxia livida, 639.
  pallida, 639.
Asphyxia neonatorum, 215, 368, 460, 617, 635.
  definition of, 635.
  diagnosis of, 641.
  etiology of, 635.
Asphyxia neonatorum:
  in first stage, 640.
  in second stage, 460, 640.
  morbid anatomy of, 639.
  prognosis of, 642.
  respiration, artificial, in, 643.
  treatment of, 642.
Aspiration of pelvic abscess, 700.
  of air-passages, 644.
Asthenia, in pregnancy, 114.
Astringents:
  in *post-partum* hæmorrhage, 587, 622.
  in puerperal hæmorrhage, 592.
  in vaginal thrombus, 628.
Atelectasis after asphyxia, 643.
Atmosphere, poisons in, causing puerperal fever, 681.
Atony, uterine, in third stage of labor, 461, 584.
  causing spontaneous version, 562.
  forceps in, 375.
  in double uterus, 278.
Atresia of genital canal, 535.
  symptoms of, 541.
  treatment of, 541.
Atresia, uterine, 539.
  from cervical thrombus, 540.
  from cicatrices, 540.
  from *conglutinatio orificii externi*, 539.
  from elongation of anterior lip, 540.
  from ovarian tumors, 548.
  from rigidity of os, 540.
  from tumors, 541, 542, 547.
  treatment of, 541.
Atresia, vaginal, 536.
  accidental, 536.
  congenital, 536.
  from cystic degeneration of vaginal walls, 538.
  from cystocele, 537.
  from ecchinococci, 538.
  from neoplasmata, 538.
  from prolapse, 537.
  from rectocele, 537.
  from retention of urine, 537.
  from thrombus, 538, 625.
  from tumors, 538.
  from vaginal hernia, 537.
  from vaginismus, 538.
  from vesical calculi, 537.
  treatment of, 541.
Atresia, vulvar, 535.
Atrophy, of uterine mucous membrane, causing abortion, 309.
Atropia, use of, in protracted first and second stages of labor, 457, 462, 650.
  injection of, in extra-uterine pregnancy, 345.
  in salivation, 121.
  in shock, 650.

Attitude of fœtus, 72 *et seq.*
Auscultation, as aid to diagnosis of pregnancy, 96, 102, 106.
Axis:
of inferior pelvic strait, 153.
of superior pelvic strait, 152.

Bacilli in puerperal fever, 666.
Bacteria:
action of, on blood, 668.
in normal lochia, 245, 684.
in puerperal fever, 666 *et seq.*, 681, 689.
Bag of waters, 132, 139, 209, 483.
in breech cases, 198.
rupture of, in abortion, 320, 353.
Ballottement, 96, 101, 104, 182, 342, 600.
in hydatidiform mole, 301.
Bandage, application of abdominal, 224, 255.
Bandl, ring of, 84, 137, 611.
views of, regarding changes in gravid uterus, 84.
Barnes's dilator:
in accidental hæmorrhage, 607.
in breech presentations, 204.
in craniotomy, 414.
in eclampsia, 580.
in hydatidiform mole, 302.
in internal hæmorrhage, 607.
in laparo-elytrotomy, 448.
in placenta prævia, 602 *et seq.*
in prolapsed funis, 631.
in protracted first stage of labor, 457, 458.
in vaginal thrombus, 627.
to induce premature delivery, 353, 356.
Bartholin, glands of, 6.
Basylist, Simpson's, 416.
Bath:
cold, in puerperal fever, 698.
in scarlatina, 263.
hot, in eclampsia, 578, 580.
in painful labor, 463.
of new-born infant, 256.
warm, in tardy labor, 457.
Battledoor placenta, 298.
Bed, preparation of, for labor, 206.
Bedstead, obstetrical, 206.
Binder, application of abdominal, 224, 255.
in relaxation of pelvic symphyses, 276.
Bismuth, subnitrate, in nausea of pregnancy, 117.
Bladder:
calculus in, obstructing labor, 537.
distention of fetal, obstructing labor, 555.
distention of, retarding labor, 456, 584.
in pregnancy, 88.
Blastodermic vesicle, 47, 50.
epiblast of, 47, 48, 50.
hypoblast of, 47, 48, 50.
mesoblast of, 47, 48, 49, 50.
Blastophore, 46.
Bleeding, in eclampsia, 579, 581.
Blood:
changes of, in pregnancy, 88, 113.
defibrinated, in emesis, 118.
development of corpuscles of, 48.
transfusion of, in *post-partum* hæmorrhage, 599.
vessels, development of, 48.
Blunt hook:
in breech cases, 388, 393.
Taylor's, 420.
use of, in craniotomy, 429.
Bodies, Wolffian, 29.
Bones, development of, 48, 64.
pressure of pelvis on, 490.
Borax, in pruritus, 122.
Bottle for artificial feeding of infants, 259.
care of, 259.
Bougies:
in protracted first stage of labor, 457.
to produce abortion, 351, 356.
Bowel, paralysis of, in puerperal fever, 678.
Brain, development of, 48, 64.
Brandy, in *post-partum* hæmorrhage, 590.
Breasts:
anatomy of, 246.
areola of:
in pregnancy, 88, 90, 94, 99.
in puerperal state, 249.
secondary, 88, 99.
care of, in puerperal state, 255.
changes in, during pregnancy, 87, 88, 90, 94, 99, 105, 106.
during puerperal state, 249.
diseases of, 701, 706.
abscesses of, 709, 711.
causes of mastitis, 709.
defective milk, 706.
erythema, 707.
galactocele, 712.
galactorrhœa, 706.
inflammation of, 709.
mastitis, parenchymatous, 709.
treatment of, 710.
nipples, fissured, 707.
nipples, sore, 706.
treatment of, 707.
erectility of, 88.
in case of fetal death, 106.
in new-born child, 250.
in puerperal state, 249, 254, 255.
of good wet-nurse, 256.
pain in, during pregnancy, 87, 94, 99.
symptoms of, relating to pregnancy, 87, 88, 90, 94, 99, 105, 106.
veins of, in pregnancy, 87, 94, 99.
Breech presentations, 169, 197, 382-390 (*vide* presentations, breech).

Breech presentations:
arms, liberation of, in, 394.
asphyxia in, 639.
causes of, 197.
configuration of fœtus in, 202.
cord, management of, in, 204, 393.
diagnosis of, 191, 198.
exceptional cases of, 395.
extraction in, 382 *et seq.*
forceps in, 388, 399, 639.
frequency of, 197.
head in, 200, 396, 399.
heart-sounds in, 103.
in contracted pelvis, 487.
in hydrocephalus, 552, 553.
irregularities in mechanism of, 201.
mechanism of, 199.
membranes, bag of, in, 193.
prognosis in, 203.
prolapse of cord in, 629.
rotation in, 199, 395.
shoulders in, 199.
traction, direction of, in, 385.
treatment of, 204.
Bregma, 70, 166.
Bright's disease, causing eclampsia, 571.
Brim of pelvis, 151, 154, 157, 169, 465 (*vide* strait, superior).
application of forceps at, 375.
circumference of, 152.
diameters of, 151, 154, 157, 169.
extraction with head at, 398.
Tarnier's forceps at, 377.
Taylor's forceps at, 377.
Broad ligaments, 14.
Bromides, use of:
in chorea, 275.
in eclampsia, 578, 580.
in emesis of pregnancy, 118, 119.
in insomnia, 122.
in nausea, 117, 119.
in puerperal insanity, 703.
Brow presentations, 169, 194, 481, 487.
configuration of head in, 194.
diagnosis of, 194.
mechanism of, 194.
prognosis in, 195.
treatment of, 196.
Bruit, uterine, in pregnancy, 96, 98, 100, 103.
effect of pains on, 97.
placental, 24, 98.
Brunettes, areola of, 88.
Bulbi vestibuli vaginæ, 4, 162.
erectility of, 5.
laceration of, 622.
pars intermedia of, 5.

Cæsarean section, 436.
abdominal wound, closure of, after, 441.
Cæsarean section:
after-treatment of, 441.
anæsthesia in, 439.
armamentarium for, 439.
assistant's duties in, 439.
checking hæmorrhage in, 440, 441, 444, 446.
closure of wound after, 441.
definition of, 436.
disinfection in, 439 *et seq.*
dressing of wound after, 439, 441.
ergot in, 441.
extraction of fœtus after, 440.
hæmorrhage in, treatment of, 440, 444, 446.
history of, 436.
incision in the abdominal wall during, 440.
incision into uterus during, 440.
indications for, 438, 494, 497, 499, 513, 518, 521, 524, 528, 533, 618, 651.
in real or apparent death of the mother, 651.
instead of abortion, 359.
instruments necessary for, 439.
in uterine tumors, 545, 548.
membranes, rupture of, in, 440.
operation of, 439.
stages in, 440.
Porro's operation in, 442.
preparations for, 439, 440.
prognosis of, 436 *et seq.*, 443, 444.
causes for bad, 443.
in lying-in hospitals, 437, 439.
removal of placenta in, 440.
statistics of, in United States, 437.
stump, treatment of, in, 446.
sutures in, 441.
Thomas's operation in, 447.
time for, 439.
treatment, after-, of, 441.
Calcareous degeneration:
of cord, 298.
of fœtus, 306, 327, 337, 340.
Calculi:
impacted, mistaken for exostoses, 537.
vesical, obstructing labor, 537.
Calomel:
in Cæsarean section, 441.
in metritis, 464.
in perimetritis, 464, 696.
Camphor, in insomnia, 122.
in pruritus, 122.
Canal, cervical, 13, 83, 106.
Canal, genital:
atresia of, 535.
ruptures of, 610.
Cancer, uterine, 310, 438, 546.
vulvar, 536.
Caput succedaneum:
in brow presentations, 194.
in contracted pelvis, 483, 489.

Caput succedaneum:
indicating forceps-delivery, 369.
in face presentations, 190.
in forceps-deliveries, 369.
in puerperal state, 250.
in vertex presentations, 181.
Carbolic acid:
in abortion, 320, 322–325, 354, 356.
in Cæsarean section, 440.
in care of cord, 256.
in erosions of cervix, 120.
in mastitis, 711.
in perineal rupture, 623.
in pruritus, 122.
in puerperal state, 224, 253, 693.
in Thomas's operation, 451.
in uterine rupture, 619.
Carbonic-acid water in nausea of pregnancy, 117.
Carbonic oxide, increase of, in blood during pregnancy, 89.
Cardiac diseases, complicating pregnancy, 266, 351, 359.
causing abortion, 266, 351, 359.
Caruncuiæ myrtiformes:
formation of, 7, 105.
Casts, in eclampsia, 567, 569 *et seq.*
Cathartics:
in eclampsia, 578, 580.
in pregnancy, 115.
in puerperal state, 254.
Catheter:
in asphyxia, 644.
in reposition of cord, 412, 634.
post-partum, 252.
Catheterization:
in labor, normal, 208.
in *post-partum* hæmorrhage, 586.
in retention, 537.
in retroflexion, 281.
of air-passages, *in asphyxia neonatorum*, 644.
uterine, to produce premature delivery, 351, 580.
Cat's chorion: villi of, 56.
Caul, 133.
Cellulitis:
in abortion, 325.
in puerperal fever, 658.
Center, motor, for uterine contractions, 126.
Cephalic version, 401.
Cephalalgia, in pregnancy, 122.
in puerperal state, 248.
Cephalotomy, 431.
Cephalotribe, 420.
action of, 422, 423.
application of, 425.
Baudeloeque's, 420.
Blot's, 421.
Cephalotribe:
dangers of, 424.
in breech cases, 388, 393.
in obstructed labor, 555.
Lusk's, 422.
objections to, 423.
Scanzoni's, 421.
Cephalotripsy, 425.
Cerebellum, development of, 48, 64.
Cerebral vesicles, 63.
Cerebrum, development of, 50, 63.
Cerium, oxalate, in nausea of pregnancy, 117.
Cervix uteri, 12, 26.
anatomy of, 13, 26.
apparent shortening of, in pregnancy, 81.
explanation of, 83.
arbor vitæ of, 13.
atresia of, 539.
canal of, 13, 83, 106.
cancer of, 310, 438, 546.
changes of, in pregnancy, 79, 80, 81–86, 95, 105, 116, 138, 282.
connective tissue of, 17.
cysts of, 542.
dilatation of, in labor, 131, 137, 139, 199, 302, 455, 483, 540.
mechanism of, 131.
dilatation of, in emesis of pregnancy, 119 *et seq.*
to induce abortion, 353, 360.
double, 277.
erectility of, 26.
erosion of, in pregnancy, 81, 116, 120.
examination of, in pregnancy, 104, 105.
ganglion of, 27, 77, 126.
glands of, 19, 81.
hyperæmia of, in pregnancy, 138.
hypertrophy of, 282.
in placenta prævia, 600.
in puerperal state, 243, 249.
laceration of, 105, 203, 539, 540, 620.
lip, anterior, obliteration of, in pregnancy, 83, 105.
mechanical dilatation of, to produce abortion, 353, 360.
mucous membrane of, 19, 81, 95.
myoma of, 542.
non-shortening of, in pregnancy, 81–83, 85.
peculiarities, anatomical, of, 26.
portio vaginalis of, 12.
lacerations of, 620.
position of, in pregnancy, 82–85, 104.
stricture of, 539.
thrombus of, 540.
tumors of, 542.
ulcers of, in puerperal fever, 656.
veins of, 26.
walls of, 17.

Child (*vide* fœtus):
asphyxia of, 215, 368, 635.
-bed, disease of, 653.
insanity of, 701.
physiology and management of, 238.
breasts of new-born, 250.
care of premature, 356.
conditions influencing size of, 69.
extraction of, in real or apparent death of mother, 650.
after perforation, 419.
icterus of new-born, 250.
length of new-born, 69.
milk prepared for, 257.
size of, 69.
weight of new-born, 69.
Chill, *post-partum*, 238, 248.
in abortion, 325.
in fetal death, 106.
in labor, 134.
in phlegmasia, 705.
in puerperal fever, 464, 671 *et seq.*
Chin, traction on, in breech cases, 396.
Chloral:
in chorea, 275.
in eclampsia, 578 *et seq.*
in emesis of pregnancy, 117, 119.
in face-ache, 122.
in insomnia of pregnancy, 122.
in puerperal insanity, 703.
in tardy labor, 457, 502.
Chloroform:
effect of, on pains, 227.
in abortion, 322.
in chorea, 275.
in craniotomy, 414.
in diagnosis of pregnancy, 102.
in eclampsia, 579, 581.
in face-ache, 122.
in labor, 210, 226, 268, 457, 463.
in pruritus, 122.
post-partum, 623.
Cholera, causing abortion, 264.
complicating pregnancy, 263.
Chorda dorsalis, 49.
Chorea, complicating pregnancy, 114, 274, 351.
indicating abortion, 351.
treatment of, 275.
Chorion:
abortion from disease of, 308.
formation of, 51, 52, 53, 64, 123.
permanent, 53.
villi of, 51, 52, 54, 55, 289, 329.
in cat, 56.
in hydatidiform mole, 298.
in mare, 55.
Cicatrices:
atresia, uterine, from, 540.
Cicatrices:
of os, obstructing labor, 540.
of vagina, obstructing labor, 536 (*vide* atresia, vaginal).
Ciliated epithelium, columnar:
in Fallopian tube, 21, 42, 328.
influence of, on migration of ovum, 42.
in glands of body, 18.
in glands of cervix, 19.
in peritonæum of batrachians, 42.
Circle of Baudelocque, 467.
Circulation:
disorders of, in pregnancy, 114, 115.
entrance of air into, 647.
fetal, 66, 68, 250, 637.
varicose veins due to disorders of, in pregnancy, 88, 115.
Cleavage of ovum, 46.
Clitoris:
anatomy of, 3, 162.
bulbs, terminal of, 3.
corpus of, 3.
crura of, 3, 162.
development of, 33, 64.
frenulum of, 4.
glans of, 3.
præputium of, 4.
Cloaca, 48.
Coccygeus muscle, 160.
Coccyx, anatomy of, 142.
mobility of, 142, 149, 534.
Codeia, in emesis of pregnancy, 119.
in insomnia, 122.
Coiling of cord, 204, 215, 296.
Coitus, in pregnancy, 113, 116.
Cold:
in abortion, 318, 321.
in mastitis, 711.
in *post-partum* hæmorrhage, 585, 627.
in puerperal fever, 697.
in puerperal mania, 703.
Collapse, in labor and childbed, 645, 648.
in abortion, 323.
in extra-uterine pregnancy, 338.
in internal hæmorrhage, 606.
in uterine rupture, 615.
Colostrum, 248.
Colpeurynter:
in abortion, 355.
in placenta prævia, 602.
Colpohyperplasia cystica:
vaginal atresia from, 538.
Columns, vaginal, 9.
Commissures, anterior and posterior, of labia, 3.
Complications of pregnancy, 260.
Computing day of confinement, 108–111.
Conception, 40, 42.
date of, 106.

Confinement, prediction of day of, 108–111.
Congenital encephalocele, 553.
Conglutinatio orificii externi:
atresia from, 539.
Conjugate diameter of pelvis, 151.
measurement of diagonal, 469, 470.
measurement of external, 469.
measurement of vera, 469, 470.
Constipation:
in pregnancy, 88, 90, 116, 118, 122, 339.
in retroflexion, with incarceration, 280.
post-partum, 240, 675, 678.
Constrictor vaginæ, 162, 214.
Contracted pelvis, 465 (*vide* pelvis, contracted).
Cæsarean section in, 438.
diagnosis of, 466.
frequency of, 466.
varieties of, 465.
Contractions, uterine, 127, 311, 454, 582.
center for uterine, 126.
hour-glass, of uterus, 462.
painless, 130, 131.
pelvic, resources of treatment in, 493.
ring, 137, 138, 462, 611, 614.
Convulsions, puerperal, 567 (*vide* eclampsia).
indicating abortion, 351.
indicating forceps, 368, 375.
in placenta prævia, 599.
Cord, umbilical, 60 (*vide* funis).
anomalies of, 293.
arteries of, 60, 61, 250.
calcareous degeneration of, 298.
care of, in abortion, 326.
in infants, 256.
coiling of, 204, 215, 296.
cysts of, 297.
degenerations of, 297.
expression of, 630.
formation of, 60, 63, 64.
fully developed, 61.
gelatin of, 61.
hæmorrhage from, 453.
hernias of, 296.
in puerperal state, 250.
knots in, 295.
laceration of, in precipitate labor, 453.
length of, 61.
ligation, late, of, 216 *et seq.*
management of, in breech presentations, 393.
marginal insertion of, 298.
prolapse of, 510, 561, 629 (*vide* funis, prolapse of).
reposition of, 631.
shortness of, causing dystocia, 559.
souffle in, 98.
stenosis of vessels of, 297, 303.
structure of, 61.
Cord:
torsion of, 293, 303.
traction on, in labor, 220, 221.
traction on, in retained placenta, 463, 593.
tying of, in labor, 215, 216, 236.
vein of, 61, 250.
vessels of, 60, 61.
Cordiform uterus, 34.
Corium, development of, 48.
Cornua, of uterus, 33.
Corpulence, causing abortion, 308.
Corpus, of uterus, 12.
Corpus luteum:
anatomy of, 39, 40.
false, 41.
formation of, 39.
true, 41.
Corrosive sublimate, use of, in obstetrics, 687, 688, 690, 692, 694.
Cortex, of ovary, 23.
Cotton, absorbent, after labor,
Cotyledon, placental, 56, 59.
Cracked nipple, 708.
Cramps in pregnancy, 88.
Cranial presentations, 169 *et seq.* (*vide* presentations, vertex).
Cranioclast, 425, 617.
action of, 425 *et seq.*
application of, 428.
Braun's, 426.
Simpson's, 425.
Craniotomy, 413.
anæsthetics in, 414.
basylist of Simpson in, 416.
before version, 430.
Blot's cephalotribe in, 421.
Blot's perforator in, 415.
Braun's cranioclast in, 426.
cephalotribes in, 421.
contraindications for, 499.
contrasted with version, 494.
craniotomy-forceps of Meigs in, 428.
crotchet and blunt hook in, 429.
dangers of, in contracted pelvis, 495.
definition of, 413.
extraction of child after, 419.
forceps in, 419.
Hodge's craniotomy scissors in, 415.
in brow presentations, 197.
in contracted pelvis, 494, 497, 499, 503, 510, 513, 519, 521, 528, 533.
indications for perforation in, 413.
in face presentations, 418.
in multiple pregnancy, 235.
in rupture of uterus, 617.
instruments used in, 414, 420.
in uterine myoma, 545.
Lusk's cephalotribe in, 422.
operation of perforation in, 414, 423.

Craniotomy:
Scanzoni's cephalotribe in, 421.
Simpson's cranioclast in, 425.
Simpson's perforator in, 414.
Smellie's scissors in, 415.
speculum in, 428.
Taylor's forceps in, 414.
Thomas's perforator in, 415.
trephine perforator in, 416, 419.
version after, 430.
Craniotractor, 426.
Cranium, fetal, 70, 165.
base of, 165.
fontanelles of, 70, 165, 180, 183.
premature ossification of, 551.
sutures of, 70, 165.
vault of, 165.
Cravings, morbid, in pregnancy, 91, 118.
Cream, use of, in artificial feeding, 257.
Credé's incubator, 357.
Credé's method of placental expression, 220.
in abortion, 324.
Cristæ vaginæ, 10, 105.
Crotchet, 429.
delivery of trunk after craniotomy with, 430.
Cul-de-sac of Douglas, 9, 15.
Cuneus, 2.
Cunnus, 2.
Curette, in abortion, 317, 320. 324, 326.
in mole, 302.
in puerperal fever, 694.
in puerperal hæmorrhage, 592.
Cyanosis neonatorum, 68 (*vide asphyxia neonatorum*).
Cystitis, in puerperal state, 252.
Cystocele:
atresia, vaginal, from, 537, 623.
obstructing labor, 537, 623.
Cysts:
in hydatidiform mole, 298, 299.
of cord, 297.
of ovary, differentiated from pregnancy, 101, 550.
of placenta, 289.
of uterine myoma, 542.
of vaginal walls, 538.

Deafness, in pregnancy, 91.
Death:
delivery of child in, 650.
fetal, causing abortion, 308.
diagnosis of, 106.
real or apparent, of mother in pregnancy or labor, 650.
sudden, in labor and childbed, 645.
Decapitation:
after failure of version, 413, 617.
Braun's decollator in, 433.
Decapitation:
in embryotomy, 432.
methods of, 432.
Pajot's method of, 434.
Decidua, 51, 53, 124, 125.
diseases of, 284.
producing abortion, 308, 309.
fatty degeneration of, 125.
glands of, 125.
in extra-uterine pregnancy, 329.
reflexa, 54, 123, 125, 286.
reparation of, in puerperal state, 241.
serotina, 54, 125, 242.
vera, 53, 123, 125, 286.
Decollator, Braun's, 433.
use of, in decapitation, 433.
Deformities, pelvic, 465 (*vide* pelvis, contracted).
absence of symphysis, 534.
contracted pelvis, 465.
exostosis, 533.
flattened pelvis, 465, 469, 474, 512.
fractures, 533.
funnel-shaped pelvis, 528.
generally contracted pelvis, 477.
irregular forms of contracted pelvis, 478, 533.
kyphotic pelvis, 479, 519.
Naegele oblique pelvis, 514.
osteomalacic pelvis, 529.
pseudo-osteomalacic pelvis, 478, 533.
rachitic pelvis, 475, 478.
Robert's anchylosed and transversely contracted pelvis, 523.
Scolio-rachitic pelvis, 521.
Spondolisthetic pelvis, 525.
Degeneration:
adipocerous, of fœtus, 304, 306.
calcareous, of cord, 298.
calcareous, of fœtus, 306.
fatty, of fœtus, 306.
hydatidiform, of placenta, 298.
placental, 299.
Delirium, in emesis of pregnancy, 118.
in labor, 701.
Delivery:
care of patient after, 224.
forceps, preparations for use of, in, 366.
immature, 307.
treatment of, 326.
premature, 307.
treatments of, 319.
Dermoid cysts of ovary, 550.
Descent of fœtus, in normal labor, 171.
in face presentation, 186.
Desquamation of new-born, 250.
Development:
of abdomen, 64.
of air-passages, 48.

Development:
of allantois, 63.
of amnion, 63, 64.
of anus, 63.
of back, 63.
of blood, 48.
of blood-vessels, 48.
of bones, 48, 64.
of brain, 48.
of cerebellum, 50.
of cerebral vesicles, 63.
of cerebrum, 50.
of chorion, 64.
of clitoris, 64.
of cloaca, 48.
of cord, 63, 64.
of corium, 48.
of digestive tract, 48.
of dorsal plates, 49, 62.
of ear, 63, 64.
of epidermis, 48.
of extremities, 63, 64.
of eyes, 63, 64.
of face, 64.
of fat, 65.
of fœtus, 48, 62.
of fontanelles, 64.
of genito-urinary organs, 48.
of glands, 48.
of hair, 48, 64, 65.
of head, 63, 64, 65.
of intestine, 48, 50, 63.
of jaws, 64.
of labia, 64.
of lanugo, 64, 65.
of lips, 64.
of lungs, 48.
of medulla, 50.
of mouth, 48, 63, 64.
of muscles, 48.
of nails, 48, 64, 65.
of navel, 65.
of neck, 64.
of nerves, spinal, 48.
of nervous system, 50.
of nose, 48, 64.
of ovum, 35, 62.
of organs of generation, female, 29.
of palate, 64.
of penis, 64.
of placenta, 64.
of rectum, 63.
of ribs, 64.
of scalp, 64.
of scrotum, 64, 65.
of skin, 48, 64.
of skull, 64.
of spinal column, 48.
of stomach, 48, 50.
Development:
of testicle, 65.
of thorax, 64.
of umbilical vesicle, 63, 64.
of uterus, 30.
of vagina, 30.
of vernix, 65.
of vertebræ, 49.
of viscera, abdominal and thoracic, 48, 62.
of visceral arches, 63.
Diabetes, complicating pregnancy, 274.
Diameters of pelvis, 150 *et seq.*, 169.
bis-iliac, 151, 468.
conjugate, 151, 469, 470.
diagonal conjugate, 469, 470.
oblique, 152, 469.
transverse, 151, 471.
Diameters of fetal head, 166 *et seq.*
Diarrhœa, in pregnancy, 90, 118.
in puerperal fever, 678.
Diet, in pregnancy, 112, 114, 117.
in puerperal state, 253.
Digestion:
disorders of, in pregnancy, 90, 93, 114, 116.
of new-born infant, 250.
Digestive tract, development of, 48.
Digital examination in labor, 207.
Digitalis, use of:
in eclampsia, 581.
in hæmorrhage, 591.
in pneumonia, 270.
in puerperal fever, 697.
in shock, 650.
in tardy labor, 457.
Dilator, Barnes's:
in accidental hæmorrhage, 604.
in breech presentations, 204.
in craniotomy, 414.
in eclampsia, 580.
in hydatidiform mole, 302.
in placenta prævia, 602–605.
in prolapsed funis, 631.
in protracted first stage of labor, 457, 458, 514.
in Thomas's operation, 449.
in vaginal thrombus, 627.
to induce premature delivery, 353.
Dilator, Gill Wylie's, use of, 127.
Diphtheritic patches in puerperal fever, 656, 657, 686.
Discus proligerus, 37, 38, 39.
Diseases complicating pregnancy, 91, 113, 261 (*vide* pregnancy, diseases complicating).
albuminuria, 91.
amaurosis, 91.
amblyopia, 91.
amniotic fluid, deficiency of, 293.
anæmia, 114.

Diseases complicating pregnancy:
anæsthesia, 91.
anomalies of cord, 293 *et seq.*
anteflexion, 116, 278.
anteversion, 80, 278.
ascites, 95.
cardiac diseases, 89, 266.
cephalalgia, 122.
cholera, 263.
chorea, 114, 274.
circulation, disorders of, 114, 115.
coiling of cord, 204, 215, 296.
constipation, 88, 90, 116.
cord, anomalies of, 293.
cysts of cord, 297.
deafness, 91.
death of fœtus, 106.
degenerations of cord, 297.
diabetes, 274.
diarrhœa, 90.
dizziness, 91.
dropsy, 88, 114, 116.
dyspnœa, 90, 114.
emesis, 93, 99, 116, 117.
emphysema, 270.
empyema, 270.
endometritis decidua, 284–286.
exanthemata, 261.
face-ache, 91, 122.
flatulence, 112.
gangrene, 115.
goitre, 89.
heartburn, 112, 121.
heart-disease, 89, 266.
hernias of cord, 296.
hydatidiform mole, 298.
hydræmia, 89, 115.
hydramnion, 95.
hypertrophy of heart, 89.
hysteria, 114.
icterus, 266.
incontinence of urine, 88.
indigestion, 90, 93, 114, 116.
insanity, 114.
maceration of fœtus, 304.
malarial fever, 122, 264.
mania, 91, 114.
mummification of fœtus, 303, 306.
nausea, 90, 93, 99, 116, 117.
neuralgia, 88, 91, 114.
œdema, 88, 114, 115.
osteophytes, 89.
palpitation, 114.
paresis, 91.
pelvis, contracted, 465.
phthisis pulmonalis, 270.
placental diseases, 287.
plethora, 88.
pleurisy, 270.
Diseases complicating pregnancy:
pneumonia, acute lobar, 269.
prolapse of uterus and vagina, 282, 283.
pruritus, 91, 121.
relapsing fever, 264.
retroflexion, 116, 279, 307, 310.
retroversion, 116, 279.
rubeola, 261.
salivation, 90, 94, 99, 118, 121.
scarlatina, 262.
small-pox, 261.
syncope, 91, 114, 118.
syphilis, 271.
tumors, uterine, 542.
typhoid fever, 264.
typhus fever, 264.
varicose veins, 88, 115.
variola, 261.
vertigo, 91, 114, 118.
vomiting, 93, 99, 116, 117, 359.
Diseases of childbed, 653.
Diseases, relations of zymotic, to puerperal fever, 685.
Displacements of uterus, 80, 116, 278, 279 *et seq.*, 310 (*vide* uterus, displacements of).
Dizziness in pregnancy, 91, 114, 118.
Dolores presagientes 124, 127, 131.
Dorsal plates, 49, 62.
Double uterus, 34, 277, 540.
Douglas, *cul-de-sac* of, 9, 15.
Douche, uterine:
in abortion, 320, 322–325, 354, 356.
in hydatid mole, 302.
in *post-partum* hæmorrhage, 589.
in puerperal fever, 688, 693, 694.
in retained placenta, 594.
Douche, vaginal:
in abortion, 320. 322.
in Cæsarean section, 440.
in forceps deliveries, 367.
in placenta prævia, 603, 606.
in pregnancy, 113.
in protracted first stage of labor, 457, 458, 502.
in pruritus, 122.
in puerperal fever, 699.
in puerperal hæmorrhage, 592.
in puerperal state, 224, 253, 693.
in retained placenta, 594.
to prevent puerperal fever, 687, 688, 692, 699.
to produce abortion or premature delivery, 354, 356.
Dress, in pregnancy, 113.
Dropsy:
complicating pregnancy, 88, 114, 115.
of amnion, 75, 95, 103, 124, 290, 561.
obscuring pregnancy, 95.

Dry labor, 455.
Ducts:
  lactiferous, 247.
  of Müller, 30.
  Wolffian, 29.
Ductus arteriosus, 66, 68, 250.
  after birth, 250, 638.
Ductus venosus, 66, 637.
Duration of pregnancy, 106.
Duverney, glands of, 6.
Dyspnœa, in pregnancy, 90, 114, 292, 351, 549, 567.
  in pulmonary embolism, 647, 648.
Dystocia, 555, 556 *et seq.* (*vide* labor, painful, obstructed, and tardy).
  from double monsters, 556.
  from fetal emphysema, 555.
Dysuria, from retroflexion of gravid uterus, with incarceration, 280.
  in cystocele, 537.
  in extra-uterine pregnancy, 339.

Ears, development of, 63, 64.
Echinococci, vaginal atresia from, 538.
Eclampsia, 567.
  abortion in, 578.
  albuminuria in, 567.
  anæsthetics in, 579.
  bath, hot, in, 580.
  bleeding in, 579.
  bromides in, 578 *et seq.*
  cathartics in, 578.
  cerebral anæmia in, 575.
  chloral in, 578 *et seq.*
  chloroform in, 579 *et seq.*
  clinical history of, 567.
  definition of, 567.
  dilator, Barnes's, in, 580.
  etiology of, 570.
  forceps in, 368, 375, 581.
  frequency of, 567.
  in cholera, 264.
  in chronic nephritis, 273.
  in placenta prævia, 599.
  in *post-partum* hæmorrhage, 590.
  in uterine tumors, 543.
  mania in, 702.
  morphia in, 579.
  œdema of brain in, 574.
  pathology of, 570.
  phlebotomy in, 579.
  prognosis in, 569.
  symptoms, premonitory, of, 567.
  terminations of, 569.
  treatment of, 577.
  uræmia in, 571, 576.
  urine in, 569, 577.
  venesection in, 579.
Écraseur, Hicks's wire, in cephalotomy, 431.
Écraseur:
  in embryotomy, 434.
  in Porro's operation, 444.
  in uterine myoma, 545.
Ectopia of abdominal organs obstructing labor, 556.
Elastic stockings in pregnancy, 116.
Elbow, diagnosis of knee from, 199.
Electricity:
  in emesis of pregnancy, 117.
  in extra-uterine pregnancy, 345.
  in induced labor, 355.
  in *post-partum* hæmorrhage, 588.
Elytrotomy in extra-uterine pregnancy, 346.
Emaciation in pregnancy, 114, 118.
Embolism, pulmonary, 645.
Embolus, pulmonary:
  collapse and death from pulmonary, in labor and childbed, 645.
  ether, in treatment of, 650.
  in puerperal fever, 660, 680.
  symptoms, 647.
  treatment, 650.
Embryo:
  anatomy of, 50, 62.
  circulation of 66–68.
  development of, 48.
  layers of, 47, 48, 62.
  nourishment of, 50.
Embryology, 62.
Embryonic area, 47, 48, 62.
Embryonic spot, 62.
Embryotome of P. Thomas, 434.
Embryotomy, 413, 431.
  decapitation in, 432.
  exenteration in, 432.
  indications for, 431.
  version in, 432.
Emesis:
  anodynes in, 117, 119.
  induction of abortion for, 118, 351, 359.
  in hydramnion, 292.
  in incarceration of retroflexed uterus, 280, 359.
  in pregnancy, 93, 99, 116, 117, 567.
    treatment of, 116, 118.
  in puerperal fever, 674, 678.
  in rupture of uterus, 615.
  in shock, 649.
  narcotics in, 119.
Emphysema:
  abortion in, 270.
  complicating pregnancy, 270.
  fetal, causing dystocia, 555.
  subcutaneous, in precipitate labor, 453.
  subperitoneal, in rupture of uterus, 616.
Empyema:
  complicating pregnancy, 270.
Encephalocele, congenital, 553.

Endocarditis:
in pregnancy, 267.
in puerperal fever, 669.
Endochorion, 53.
Endocolpitis, in puerperal fever, 656, 671.
Endometritis, cervical, 539.
Endometritis decidua, complicating pregnancy, 272, 284, 310.
Endometritis decidua catarrhalis, or *hydrorrhœa gravidarum*, 286.
Endometritis decidua chronica diffusa, 284.
Endometritis decidua polyposa, 285.
Endometritis decidua tuberosa, 285.
Endometritis in puerperal fever, 656, 657, 671.
Enema, in eclampsia, 580.
in labor, 203.
nutritive, in pregnancy, 114, 118.
post-partum, 254.
Epiblast, 46–48, 50.
Epiblastic spheres, 46.
Epidermis, development of, 48.
in maceration of fœtus, 304.
Episiotomy, 214.
Epithelium, cylindrical, ciliated:
in glands of cervix, 19, 81, 95.
in glands of uterus, 18, 20.
of breast, 247.
of ovary, 23, 36.
of ovum, 37.
of tube, 21, 42.
Erectility:
cervical, 26.
of nipple, 88.
of Fallopian tube (theoretical), 41.
of vaginal bulbs, 5.
ovarian (theoretical), 27.
uterine (theoretical), 26.
vaginal (theoretical), 9.
Ergot:
contraindications for, in parturition, 461.
indications for, in parturition, 224, 460, 607.
physiological action of, 460.
use of, after normal labor, 224, 460, 688.
in abortion, 320, 321, 323.
in Cæsarean section, 441.
in hydatid mole, 302.
in long second stage, 460.
in parturition, 224, 460.
in placenta prævia, 603, 606.
in *post-partum* hæmorrhage, 585.
in protracted first stage of labor, 457, 458, 461, 511.
Ergotin, for varicose veins, 116.
in abortion, 323.
Erosions, on cervix, in pregnancy, 81, 116, 120.
in puerperal state, 243.
treatment of, 116, 120.
Erotomania, 702.
Erysipelas, how related to puerperal fever, 686.
Estimation of date of confinement, 108.
Ether:
in abortion, 322.
in anæmia, cerebral, 590.
in Cæsarean section, 439.
in embolism, pulmonary, 650.
in forceps delivery, 367.
in labor, 226.
in lacerations, 623.
in nausea of pregnancy, 117.
in pulmonary embolism and shock, 650.
post-partum, 623.
Eunuchs, female, genital organs of, 156.
Eustachian valve, 66, 68, 637.
Evisceration, 432.
Evolutio conduplicato corpore, 564, 565.
Evolution, spontaneous, 564.
etiology of, 564.
mechanism of, 565.
prognosis, 566.
Examination of patient:
method of conducting, in labor, 206.
in pregnancy, 99.
Exanthemata in pregnancy, 261.
Exenteration, in embryotomy, 432.
Excavatio:
recto-uterina, 15.
vesico-uterina, 15.
Exercise, in pregnancy, 113, 122.
Exhaustion, nerve, and shock, 648.
treatment, 650.
Exochorion, 53.
Exostosis, pelvic deformity from, 533.
Expression of head, in labor, 212.
Expression of placenta:
by Crédé's method, 220, 324.
in contracted pelves, 506.
in irregular pains of third stage of labor, 459, 463.
in placenta prævia, 603.
Expulsion, spontaneous, 564.
Extension, of fetal head, in face presentations, 186.
of fetal head, in normal labor, 177.
External rotation:
in face presentations, 188.
in normal labor, 177.
Extraction of fœtus:
after perforation, 419, 428.
by breech, in breech presentations, 385.
by feet, in breech presentations, 384.
by forceps, in breech cases, 388.
in Cæsarean section, 440.
in craniotomy, 419.
in foot and breech presentations, 382 *et seq.*
in pelvic presentations, 382.

Extraction of fœtus:
in real or apparent death of mother in pregnancy or labor, 650.
relief of arms in, 394.
Extraction of trunk in breech cases, 384.
Extra-uterine pregnancy (*vide* pregnancy, extra-uterine), 280, 327.
abdominal, 327, 335, 339.
collapse in, 338.
definition of, 327.
diagnosis of, 280, 340.
electricity in, 345.
elytrotomy in, 346.
hæmorrhage in, 327, 346.
interstitial, 332.
ovarian, 327, 328, 338.
peritonitis in, 339, 340.
secondary, 339.
symptoms of, 338.
terminations of, 327, 333, 339.
tubal, 327, 328.
tubo-abdominal, 338.
tubo-ovarian, 338.
treatment of, 343.
(*a*) in cases of early gestation, 343.
(*b*) in cases of advanced gestation, 346.
(*c*) in cases of gestation, after death of fœtus, 348.
Eyes, development of, 63, 64.

Face-ache in pregnancy, 122.
Face, development of, 64.
Face-presentations (*vide* presentations, face), 169, 184, 186.
abnormal mechanism of, 188.
causes of, 184, 481, 487.
configuration of head in, 189.
craniotomy in, 418.
descent in, 186.
development of, 64.
diagnosis of, 190.
extension of fetal head in, 186.
external rotation in, 188.
flexion of fœtus in, 188.
forceps in, 381.
frequency of, 184.
heart-sounds in, 103.
mechanism of, 186.
membranes, preservation of, in, 191.
mistaken for breech, 191.
perforation in, 418.
prognosis in, 191.
prolapse of cord in, 630.
rotation of fœtus in, 187.
treatment of, 191, 456.
Fallopian tubes, 12, 19, 30.
ampulla of, 19.
anatomy of, 19, 30.
cylindrical ciliated epithelium in, 21, 42, 328.
Fallopian tubes:
dilatation of, in atresias, 541.
fecundation in, 42.
fimbriæ of, 19.
in extra-uterine pregnancy, 328.
infundibulum of, 42.
isthmus of, 19.
mucous membrane of, 21.
muscles of, 20.
non-erectility of, 41.
ostium abdominale of, 19.
position of, in pregnancy, 79.
Famine, causing abortion, 308.
Faradism:
in emesis of pregnancy, 117.
in extra-uterine pregnancy, 345.
in *post-partum* hæmorrhage, 588.
Fascia, pelvic, 161.
Fat, in abdominal wall, obscuring pregnancy, 102.
Fat, development of, 65.
Fatty degeneration of fœtus, 306.
Fecundation, 42–44.
changes in ovum after, 44.
Feeding, artificial, of infants, 257.
natural, of infants, 254.
Fæces, of infants, 251.
Fever:
malarial, complicating pregnancy, 264.
complicating the puerperal state, 653.
milk, 247.
puerperal, 653 (*vide* puerperal fever).
relapsing, in pregnancy, 264.
scarlet, complicating pregnancy, 262.
typhoid, in pregnancy, 264.
typhus, in pregnancy, 264.
Fibroid tumors, differential diagnosis of, from pregnancy, 101.
of placenta, 290.
Fillet, use of, in breech and foot cases, 388, 391.
in version, 411.
Fimbriæ:
of Fallopian tube, 19.
ovaricæ, 42.
Fissure of nipple, 707.
Fistulæ after Thomas's operation, 449.
caused by calculi, 537.
caused by contracted pelvis, 466, 489, 541, 622.
caused by slow labor, 368.
Flattened pelvis, 465, 469, 474, 512.
non-rachitic, 474.
rachitic, 475.
irregular, 478.
Flatulence in pregnancy, 112.
Flexion of fetal head:
advantages of, 172.
in contracted pelves, 486.

Flexion of fetal head:
in face presentations, 188.
in normal presentations, 171.
Floor, pelvic or perineal, 159, 160.
Fluctuation, uterine, in pregnancy, 100.
Fluid, amniotic, 61.
anomalies of, 290.
composition of, 61.
deficiency of, 293.
obscuring pregnancy, 95.
Fœtus:
abdominal enlargement of, obstructing delivery, 554.
abnormalities of, obstructing delivery of trunk, 554.
abnormalities of, obstructing labor, 551.
adhesions of, causing dystocia, 556.
adipocerous changes in retained, 304, 306.
anasarca of, causing dystocia, 555.
anchylosis of joints of, 518, 556.
ascites of, obstructing delivery, 554.
at term, 68, 165.
attitude of, 72 *et seq.*
bladder, dilatation of, 554.
causes of death of, 308.
circulation of, 66–68, 250, 637.
configuration of, in breech presentations, 202.
congenital hydrocephalus of, 551.
cord of, anomalies and diseases in, 293.
cranium of, 70, 165, 551.
dead, retention of, *in utero*, 302.
death of, 106, 308.
from torsion of cord, 294.
indicating abortion, 350.
in nephritis, 273.
producing abortion, 308.
degeneration, adipocerous, of, 306.
calcareous, of, 306.
fatty, of, 306.
of liver of, 555.
descent of, in labor, 171.
development of, 62.
in successive months, 62.
in first month, 62.
in second month, 64.
in third month, 64.
in fourth month, 64.
in fifth month, 64.
in sixth month, 65.
in seventh month, 65.
in eighth month, 65.
in ninth month, 65.
in tenth month, 65.
diagnosis of death of, 106.
diameters of head of, 166 *et seq.*
diseases of, obstructing delivery of its head, 551.
ectopia of viscera of, 556.
Fœtus:
emphysema of, 555.
encephalocele of, obstructing labor, 553.
extraction of:
in breech and foot presentations, 382 *et seq.*
in Cæsarean section, 440.
in craniotomy, 419.
in pelvic presentations, 382 *et seq.*
instruments for, 414, 419.
with head at brim, 398.
face of, 70, 165.
fatty degeneration of, 306.
flexion of, in labor, 171, 172, 188.
fontanelles of, 70, 165, 183, 551.
funis of, anomalies in, 293.
habitual death of, as cause for inducing abortion, 350.
head of, at term, 70, 105, 165 *et seq.* (*vide* head, fetal).
heart-sounds of:
in asphyxia, 641.
in breech presentations, 105.
in face presentations, 105, 190.
in head presentations, 105, 183.
in hydatidiform mole, 301.
in hydramnion, 292.
in hydrocephalus, 552.
in pregnancy, 96, 97, 101, 103, 106.
in tardy labor, 460.
hydrocephalus of, obstructing labor, 551.
hydrothorax of, obstructing labor, 554.
in extra-uterine pregnancy, 340.
in first month, 62.
in second month, 64.
in third month, 64.
in fourth to eighth month, 65.
in ninth to tenth month, 65.
lanugo of, 62, 64, 68, 69.
length of, at term, 69.
liver of, fatty degeneration of, 555.
maceration of, 304.
meconium of, 62, 69, 199, 250.
monstrosities developed from, 556.
movements of, in pregnancy, 75, 95, 96, 98–100, 106.
active and passive, 96.
in hydatidiform mole, 301.
mummification of, 303, 306.
pancreas of, enlarged, 555.
papyraceus, 231.
positions of, 72, 76, 170.
classification of, 170.
first, 76.
in multiparæ, 75.
in pluriparæ, 75.
occipito-posterior, 170, 179.
second, 76.
presentations of, 72 (*vide* presentations).

Fœtus:
pressure-marks on head of, 490.
putrefaction of, in retention of, 302, 305, 312.
release of arms of, 394.
retention, *in utero*, of dead, 302, 547.
rotation of, in labor, 173.
sanguinolentus, 304.
size of, in successive months, 62 *et seq.*
spleen of, enlargement of, 555.
sutures of, 70, 165, 183.
tumors of trunk of, obstructing labor, 554, 555.
urine of, 61, 250.
vernix caseosa of, 68.
weight of, at term, 69.
Folds, medullary, 48.
Follicles, Graafian, 23, 35, 36 (*vide* Graafian follicles).
sebaceous, of areola, 88, 99.
Fontanelles, 64, 70, 165, 183.
closure of, in obstructed labor, 551.
in hydrocephalus, 552.
large, 70, 166.
small, 70, 166.
Foot presentations, 169.
diagnosis of, 198.
extraction in, 382 *et seq.*
management of cord in, 393.
Foramen ovale, 66, 68, 250.
after birth, 250.
valve of, 66, 68.
Foramen, obturator, 158, 159.
Forceps, 361.
action of, 365.
after-coming head, to, 399.
anæsthetics in application of, 367.
application of, 369, 376.
to after-coming head, 399.
asphyxia from, 639.
at the pelvic brim, 375.
at the pelvic outlet, 368.
blades, introduction of, 369, 376.
breech, of Miles, 388.
Chamberlen's, 361.
Chapman's, 362.
contrasted with version and craniotomy, 493 *et seq.*
craniotomy of Meigs, modified, 429.
deliveries by, preparation for, 366.
douche, before, 367.
Hodge's, 365, 420.
history of, 361.
in abortion, 356.
in atony of uterus, 368.
in brow presentations, 197.
in contracted pelvis, 497, 503, 508, 511 *et seq.*
in craniotomy, 419.
Forceps:
in death of mother, 651.
indications for, 366, 369, 545, 651.
at pelvic outlet, 368.
in double vagina, 538.
in eclampsia, 581.
in face presentations, 381.
in foot and breech presentations, 388.
in heart-disease, 268.
in multiple pregnancy, 235.
in occipito-posterior positions, 379.
in placenta prævia, 603.
in premature labor, 356.
in prolapse of funis, 631.
in prolapse of vagina, 283.
in protracted second stage of labor, 457, 458, 460.
in rupture of uterus, 617.
introduction of blades of, 369, 376.
in Thomas's operation, 450.
in vaginal prolapse, 283.
in vaginal thrombus, 627.
lacerations from, 621.
Levret's, 364.
locking of, 372.
long, 363.
Lusk's modification of Tarnier's, 378, 379.
Naegele's, 364.
operation of introduction of, 369, 376.
ovum-, use of, in abortion, 324.
position for, 367.
preparation for delivery by, 366.
removal of, 374.
selection of, 362, 365.
short, 362.
Simpson's, 364, 379.
Smellie's, 363.
Tarnier's, 377, 390, 400, 513, 581.
Tarnier's, modified by Lusk, 378, 379.
Taylor's, at brim, 377, 513.
Taylor's narrow-bladed, 377, 414.
time for application of, 369.
traction on, direction of, 366, 372, 373, 377.
vol-sella, 432.
Wallace's, 365.
White's, 365.
Forces, expellent, action of, 135.
anomalies of, 452.
Fornix, 9, 613.
laceration of, 621.
Forehead, spots on, in pregnancy, 91.
Fourchette, 4.
Fowler's solution in nausea, 117.
Fractures, caused by contracted pelvis, 491.
causing pelvic deformities, 533.
Frenulum clitoridis, 4.
Frenulum vulvæ, 4.
in pregnancy, 105.
laceration of, in labor, 134.

Fundus of uterus, 12.
development of, 30.
Fungi in milk, 258.
Funic souffle, 98.
Funis, 60, 64 (*vide* cord, umbilical).
anomalies of, 293 *et seq.*
arteries of, 60, 61.
calcareous degeneration of, 298.
care of, in abortion, 326.
in infants, 256.
coiling of, 204, 215, 296.
cysts in, 297.
diseases of, 297.
expression of, 630.
formation of, 60.
fully developed, 61.
gelatin of, 61.
hæmorrhage from, 453.
hernias of, 296.
in puerperal state, 250.
knots in, 295.
laceration of, in precipitate labor, 453.
length of, 61.
ligation, late, of, 216.
management of, in breech presentations, 393.
marginal insertion of, 298.
presentation of, 629.
prolapse of, 510, 561, 629.
diagnosis of, 630.
in breech cases, 204.
prognosis of, 630.
treatment of, 631.
postural, 632.
reposition of, 631 *et seq.*
by instruments, 634.
by postural treatment, 632.
shortness of, causing dystocia, 559.
souffle in, 98.
stenosis of vessels of, 297.
structure of, 61.
torsion of, 293.
tying, in labor, 215, 236.
vein of, 60, 61.
vessels of, 60, 61.
Funnel-shaped pelvis, 528.

Gait, feminine, 154.
Galactocele, 712.
Galactorrhœa, 706.
Galvanism, in extra-uterine pregnancy, 345.
Galvanization to produce premature labor, 355.
Galvano-cautery, in Thomas's operation, 451.
Ganglion, cervical, 27, 77, 126, 127.
in pregnancy, 77, 127.
Gangrene, from œdema of pregnancy and labor, 115, 536.
Gastrotomy (*vide* Cæsarean section):
in puerperal peritonitis, 699.
in uterine rupture, 618.
Gauze, iodoform, in puerperal state, 688.
Gelatin of Wharton, 61.
Gelsemium, in face-ache, 122.
Generation:
anatomy of female organs of, 1.
development of female organs of, 29, 48.
Genital canal:
atresia of, 535.
symptoms of, 541.
ruptures of, 610 (*vide* lacerations).
uterine atresia of, 539.
vaginal atresia of, 536.
vulvar atresia of, 535.
Germinative spot, 39.
Germinative vesicle, 39, 45.
disappearance of, 45.
Germs in puerperal fever:
bacteria, 666 *et seq.*, 681, 689.
micrococci, 666 *et seq.*, 681, 689.
Gill Wylie's treatment of emesis, 120.
Glandulæ vestibulares:
majores, 6.
minores, 5.
Glands:
Bartholin's, 6.
cervical, 19.
decidual, 125.
Duverney's 6.
labial, 5.
mammary, anatomy and changes of, in pregnancy, 87, 88, 90, 94, 99, 105, 106, 247.
mucous, of the vulva, 5.
salivary, activity of, in pregnancy, 90, 94, 99, 118, 121.
sebaceous, of the nymphæ, 5.
of areola, 88.
thyroid, changes in, during pregnancy, 89.
uterine, 18.
post-partum, 242.
vaginal, 10, 162.
vulvar, 5, 162.
Glans clitoridis, 3.
Goitre, in pregnancy, 89.
Graafian follicles, 23, 35, 36.
developed, 38.
discus proligerus in, 37, 38.
macula of, 39.
membrana granulosa of, 37.
membrana propria of, 37.
number of, 38, 39.
stigma of, 39.
theca folliculi of, 36, 38.
tunica fibrosa of, 36, 38.
tunica propria of, 36, 38.
young, 38.

Gravid uterus:
anteflexion of, 116, 278.
anteversion of, 80, 278.
hernia of, 283.
prolapse of, 282, 359.
retroflexion of, 116, 279, 359.
with incarceration, 280, 359.
treatment of, 280.
retroversion of, 116, 279.
Gravitation, causing head presentations, 74.
Groove, primitive, 48.
Guarana, in cephalalgia, 122.
Gummata, placental, 290.

Hæmatoma:
in uterine rupture, 615.
Hæmoglobin in pregnancy, 89.
Hair, development of, 48, 64, 65.
Hallucinations, in emesis of pregnancy, 118.
Hand, selection of, for version, 406, 407.
Hæmatocele, in extra-uterine pregnancy, 339.
Hæmatoma tubæ, 339.
vulvar, 536.
Hæmorrhage:
accidental, 594, 597, 606.
concealed, 606.
external, 606.
forceps indicated by, 366, 375.
from cervical laceration, 620.
from normally implanted placenta, 606.
in abortion, 309, 311, 312, 313, 319, 320, 325, 326.
in Cæsarean section, control of, 440.
in contracted pelvis, 488, 491.
in extra-uterine pregnancy, 327, 338, 339.
in labor, third stage of, 134.
in multiple pregnancy, 236.
in placenta prævia, 597, 599, 601, 605.
internal, 606.
in Thomas's operation, 449, 451.
in uterine cancer, 547.
in vaginal thrombus, 627.
post-partum, 249, 581.
anodynes in, 585.
armamentarium for, 585.
astringents in, 587, 622.
causes of, 279, 569, 583, 620, 622, 627.
chloroform, effect of, on, 227, 623.
disturbances of contractility as cause of, 583.
disturbances of retractility as cause of, 584.
disturbances of thrombus formation, causing, 584.
electricity, use of, in, 588.
ergot in, 461.
in contracted pelvis, 492, 495.
in double uterus, 278.
in fevers, 264.
Hæmorrhage:
in forceps-deliveries, 372.
in hydramnion, 292.
in lacerations, 620.
in multiple pregnancy, 236.
in placenta prævia, 601, 605.
in premature labor, 309, 311, 312, 313, 319, 325, 326, 339.
in precipitate labor, 453.
intra-uterine injections in:
of iodine, 587.
of iron, 587.
in uterine tumors, 542, 543, 547.
methods of producing uterine contractions in, 585.
methods of producing uterine retractions in, 589.
normal agencies for checking, 582.
outlying causes of, 584.
symptoms of, 589.
transfusion of blood in, 590.
transfusion of milk in, 590.
treatment of, 461, 585, 622, 627.
treatment of cerebral anæmia in, 589.
puerperal, 592.
astringents in, 592.
treatment of, 592.
unavoidable, 597, 606.
vinegar in, 588.
Hæmorrhoids, in pregnancy, 88, 115, 130.
in puerperal state, 254.
Head, fetal, 70, 165.
after-coming, forceps applied to, 399.
perforation of, 418.
articulations of, with spine, 168.
at term, 165.
base of, 165.
circumference of, 168.
configuration of, in breech presentations, 209, 396, 399.
in brow presentations, 194.
in contracted pelvis, 489.
in face presentations, 189.
in vertex presentations, 180.
descent and extension of, in face presentations, 186.
descent and flexion of, in labor, 171, 486.
development of, 63–65.
diameters of, 166 *et seq.*
diseases which obstruct delivery of, 551.
entrance of, into pelvis, 171.
extension of, in labor, 177.
external rotation of, in face presentations, 188.
external rotation of, in labor, 177.
extraction of, in breech cases, 396, 398.
flexion of, in face presentations, 188.
fontanelles of, 64, 70, 165, 183.
molding of, in vertex presentations, 179.

Head:
positions of, 170.
presentations, 72–75, 168.
heart-sounds in, 103.
restitution of, 178.
rotation of:
in breech presentations, 199, 395.
in brow presentations, 194.
in face presentations, 103, 187.
in normal labor, 173.
in vertex presentations, 173.
scalp-tumor on, 181, 190, 194 (*vide caput succedaneum*).
sinking of, 105.
sutures of, 165.
vault of, 165.
Headache in pregnancy, 122.
in eclampsia, 567, 569.
post-partum, 248.
Heart:
diseases of, complicating pregnancy, 89. 266, 310, 351, 359.
hypertrophy of, in pregnancy, 89.
sounds, fetal, in pregnancy, 96, 97, 101, 103, 106, 342, 460, 641.
disappearance of, in pregnancy, 105.
effect of pains on, 97.
frequency of, in the sexes, 97.
maximum intensity of, 98.
in hydramnion, 292, 293.
in hydrocephalus, 552.
Heart-burn in pregnancy, 121.
Hemicephalus, 559.
Hemispheres, cerebral, development of, 50, 63.
Hernia:
congenital, 550.
of cord, 296.
of gravid uterus, 283.
of vagina, atresia from, 537.
of vulva, 538.
Hiatus sacralis, 142.
Hilum, of ovary, 22.
Hips, widening of, in pregnancy, 86.
Hodge's forceps, 365, 420.
Hook:
blunt, 388, 393, 430.
in breech and foot cases, 388, 393.
in craniotomy, 430.
Braun's decapitating, 433.
Ramsbotham's decapitating, 434.
Taylor's, 430.
Hospitals, maternity, 686 *et seq.*
Hottentot apron, 4.
Hour-glass contraction of uterus, 224, 462.
Hydatidiform mole, 231, 298.
abortion in, 301.
anatomy, morbid, of, 298.
diagnosis of, 301.
etiology of, 300.
Hydatidiform mole:
prognosis of, 301.
symptoms of, 301.
treatment of, 302.
Hydatids, pelvic, causing atresia, 538.
Hydræmia of pregnancy, 89, 115, 280, 574.
Hydramnion, 75, 95, 103, 290.
as cause for abortion, 124.
as cause of precipitate labor, 292.
as cause of tardy labor, 455, 584.
diagnosis of, 293.
etiology of, 290.
indicating abortion, 351.
in hydrocephalus, 552.
obscuring pregnancy, 95, 103.
prognosis of, 293.
symptoms and signs of, 292.
treatment of, 293, 456.
in labor, 456.
Hydrocephalus, 551.
causing uterine rupture, 612.
diagnosis of, 552.
etiology of, 552.
following premature labor, 349.
mechanism of labor in, 553.
morbid anatomy of, 552.
prognosis in, 553.
treatment of, 553.
Hydrorrhœa gravidarum, 286.
Hydrothorax, fetal, obstructing labor, 554.
Hygiene of pregnancy, 112.
Hymen:
anatomy of, 6.
annularis, 7.
atresia of, 535.
cribriformis, 7.
fimbriatus, 7.
imperforatus, 7.
in pregnancy, 105.
in puerperal state, 249.
Hyoscyamus in insomnia, 122.
Hyperæmia, venous, in pregnancy, 115.
Hyperosmia in pregnancy, 118.
Hypertrophy, of uterine mucous membrane, causing abortion, 310.
Hypnotics in pregnancy, 122.
Hypoblast, 47, 48, 50.
Hypoblastic spheres, 46.
Hysterectomy, for myoma, 544.
Hysteria, in pregnancy, 114, 708.
Hysterotomy, 424 (*vide* Cæsarean section).
in hernia of uterus, 284.

Ice, use of, in nausea of pregnancy, 117, 119.
in hæmorrhage, 587, 588.
in mastitis, 711.
in puerperal fever, 698.
Icterus:
abortion in, 266.

Icterus:
in pregnancy, 266.
neonatorum, 219, 250.
Ileus, due to retroflexed gravid uterus, 280.
Ilia, anatomy of, 142, 143, 150, 468.
Ilio-pectineal line, 144.
Imperforate anus, 256, 296.
Impregnation, 42–44 (*vide* fecundation).
Incarceration of retroflexed gravid uterus, 116, 279, 359.
of prolapsed uterus, 282.
treatment of, 280, 316, 359.
Incisions, vulvar, in labor, 214.
Incontinence of urine in pregnancy, 88, 279.
Incubator:
Credé's, 357.
Tarnier's, 358.
Indigestion in pregnancy, 88, 90, 114.
Inertia uteri, 454.
causes of, 282, 292, 455, 598.
treatment of, 456.
Infant, new-born, 250 (*vide* newly born child).
artificial feeding of, 257.
bath of, 256.
bottle for, 259.
breasts of, 250.
caput succedaneum of, 181, 190, 250.
cardiac ventricle of, 250.
care of, 256, 356.
care of bottle of, 259.
of cord of, 256.
changes in circulation of, 216, 250.
circulation of, affected by thoracic aspiration, 218.
cord, late ligation of, in, 216.
digestion of, 250.
ductus arteriosus of, 250.
fæces of, 251.
foramen ovale of, 250.
icterus of, 219, 250.
loss of weight of, 251.
meconium of, 250.
navel of, 250.
nursing of, 254.
ophthalmia of, 712.
selecting wet-nurse for, 256.
skin of, 250.
sprue in, 259.
tumor on presenting part of, 250.
umbilicus of, 250.
urine of, 250, 251.
weight, loss of, in, 251.
wet-nurse for, 256.
Infarctions, puerperal, 668.
Infarctions, placental, 288.
Infectious diseases complicating pregnancy, 260.
Infundibulum tubæ, 42.
Injections:
between uterus and ovum, to produce abortion, 352.
hypodermic,
in anæmia, cerebral, 590.
in embolism, pulmonary, 650.
intra-uterine, in *post-partum* hæmorrhage, 587.
intra-uterine, in puerperal fever, 688, 693, 694.
in puerperal hæmorrhage, 592.
vaginal,
after removal of retained placenta, 594.
in protracted first stage of labor, 457, 502.
to prevent puerperal fever, 687, 688, 692, 699.
to produce abortion, 354.
Inoculation, causing puerperal fever, 683.
Insalivation in pregnancy, 90, 94, 99, 118, 121.
Insanity:
in pregnancy, 91, 114, 701.
of lactation, 701, 703.
puerperal, 701, 703.
Insertion, marginal, of cord, 298, 630.
Insomnia in pregnancy, 122, 292.
Insufflation *in asphyxia neonatorum*, 643.
Internal version, 401, 405.
Interstitial pregnancy, 332.
Intestine:
development of, 48, 50, 63.
Intoxication, putrid, 666.
Inversio uteri, 607.
treatment, 608.
Involution, uterine, 240.
Iodine, injection of, 693.
in *post-partum* hæmorrhage, 587.
Iodoform gauze, use of, *post partum*, 592, 688, 700.
in hæmorrhage, 589, 592.
Iodoform in pelvic abscess, 700.
Iodoform suppositories, in puerperal state, 694.
Iron:
injection of, in *post-partum* hæmorrhage, 587.
in puerperal fever, 693.
in puerperal hæmorrhage, 587.
in albuminuria, 577.
in chorea, 275.
in hydatid mole, 302.
in phlegmasia, 706.
in pregnancy, 114, 122.
Ischia, anatomy of, 142, 144.
spine of, 145, 153.
tuberosity of, 145.
Ischio-cavernosus, 162, 163.
Ischuria, in vaginal thrombus, 626.
Isthmus of Fallopian tube, 19.

Jaundice:
in new-born child, 250.
in pregnancy, 266.
Jaws, development of, 64.
Joints:
anchylosis of fetal, obstructing labor, 556.
mobility of pelvic, in labor, 148, 275.
pelvic, 145, 275.
sacro-iliac, 145.

Kidneys:
cystic degeneration of fetal, 554.
diseases of, indicating abortion, 359.
pathological changes of, in eclampsia, 569 *et seq.*
Kiesteine, 94.
Knee, diagnosis of, from elbow, 199.
Knots in umbilical cord, 295.
Koumyss, in emesis of pregnancy, 117.
Kyphotic pelvis, 479, 519.

Labia, changes in, during pregnancy, 86.
adhesions of, 535.
Labia majora, 2, 64.
changes in, during gestation, 86, 104, 105, 115, 131.
commissures, anterior and posterior, of, 3.
development of, 64.
gangrene of, 536.
hernia of, 538.
œdema of, in pregnancy and parturition, 86, 115, 131, 134, 249, 536, 567, 577.
thrombosis of, 5, 536, 625.
Labia minora, 3.
sebaceous glands of, 5.
post partum, 249.
Labor, 123.
action of abdominal muscles in, 129.
action of expellent forces in, 135.
action of pains on uterine walls in, 128.
action of vagina in, 129.
anæmia in, 645.
anæsthetics in, 225.
antisepsis in, 225, 688 *et seq.*
armamentarium for, 206.
bag of waters in, 132.
bed, preparation of, for, 206.
cancer of cervix in, 547.
catheterization in, 208.
causes of, 123.
cervical dilatation in, 131, 137, 139.
cervical laceration in, 131.
chill in, 134.
chloroform in, 210, 226.
clinical course of, 123, 130.
collapse in, 645, 648.
contraction of uterine ligaments in, 128.
contractions, uterine, in, 127, 131, 135, 462.

Labor:
painless, causing cervical dilatation, 81, 130 *et seq.*
cord, care of, in, 215.
date, computation of, 108–111.
death, sudden, in, 645, 650.
definition of, 123.
delirium in, 701.
dry, 455.
duration of, 135, 207.
eclampsia in, 567.
enemata in, 208.
episiotomy in, 214.
ergot in, 224, 457, 458, 460, 461, 511.
ether in, 226.
examination in, 99, 206,
expulsion of trunk in, 178.
extension of head in, 177.
external rotation in, 177, 188, 201.
faintness in, 134.
false, 464.
fever in, 464.
forceps in, 369.
hæmorrhage in third stage of, 134.
labia in, 131.
laceration of frænulum in, 134.
laceration of perinæum in, 134.
mechanism of, 140, 168.
abnormal, in vertex presentations, 179.
in abnormal face presentations, 188.
in breech presentations, 199.
in brow presentations, 194.
in contracted pelvis, 484, 495, 502.
in face presentations, 186.
in irregular breech presentations, 201, 564.
in normal presentations, 171.
in occipito-posterior positions, 179.
with monstrosities, 557.
normal, 171.
descent and flexion in, 171.
rotation in, 173.
extension in, 177.
external rotation in, 177.
restitution in, 178.
expulsion of trunk in, 178.
metritis in, 464.
missed, 304, 305.
natural, 169, 171.
normal, 171, 205.
anæsthetics in, 210, 225, 268, 457.
armamentarium for, 206.
bed in, 206.
care of patient after, 224.
chloroform in, 226, 457.
conduction of, 205.
cord, care of, in, 215.
delivery of shoulders in, 178, 199, 215, 396.

Labor:
duration of, 207.
enema in, 208.
examination of patient in, 206.
management of first stage of, 208.
management of second stage of, 209.
management of third stage of, 220.
placental period of, 134.
posture in, 208–210.
preliminary preparations for, 205.
preservation of perinæum in, 193, 210.
retention of urine in, 208.
treatment of lacerations after, 224.
tying cord in, 215.
obstructed, 551 (*vide* obstructed labor).
œdema in, 130, 368.
painful, 463.
anæsthetics in, 463.
cessation of, after diaphoresis, 463.
from hysteria, 463.
from inflammation of or around genital organs, 464.
from intestinal irritation, 464.
from rheumatism, 463.
painless, 130.
pains of, 127, 129, 452.
contracted pelvis affecting, 481.
influence of, on organism, 130.
pathology of, 452.
pelvis, contracted, complicating, 479.
phenomena, clinical, of, 123, 130.
physiology of, 123, 127.
posture in, 208–210.
precipitate, 453.
consequences of, 453.
in hydramnion, 292.
treatment of, 453.
prediction of date of, 108–111.
premature, 307, 349, 500 (*vide* abortion).
care of child after, 356.
catheterization of uterus to produce, 351.
choice of methods to produce, 356.
from puncture for œdema of pregnancy, 115.
in anæmia of pregnancy, 115.
in cholera, 264.
in heart diseases, 268.
indications for, 349, 500, 578, 600, 616.
induction of, 349.
in emesis of pregnancy, 119.
injections between uterus and ovum to produce, 352.
mechanical dilatation of cervix to produce, 353.
operations to produce, 351.
rupture of membranes to produce, 353.
tampon, vaginal, to produce, 355.
time for, 349.
vaginal douche to produce, 354.
Labor:
preparations for, 205.
preservation of perinæum in, 210 *et seq.*
pressure of uterus in, 140.
pulse in, 130, 464.
rupture of membranes in, 132, 140, 208.
stage of:
first, 131.
anæsthetics in, 226.
anodynes in, 456.
bloody discharge in, 131.
influence of contracted pelvis on, 483, 495, 502.
irregular pains in, 454.
management of, 208, 454.
pains in, 131.
posture in, 208–210.
treatment of long, 456, 650.
second, or stage of expulsion, 133.
anæsthetics in, 210, 225.
forceps in, 369.
irregular pains in, 459.
management of, 209.
pains in, 133.
perinæum in, 134, 210 *et seq.*
posture in, 210.
treatment of long, 459.
urethra in, 134.
third or placental period, 134.
anæsthetics in, 227.
atony in, 458.
chill in, 134.
in multiple pregnancy, 282.
irregular pains in, 461.
management of, 220, 461.
symptoms, precursory, of, 130.
syncope in, 134, 645.
tardy, 453.
anodynes in, 456.
Barnes's dilator in, 457, 458.
bougies in, 457.
causes of, 455.
douche, vaginal, in, 457, 458.
ergot in, 458, 460.
expression in, 459.
hour-glass contractions of uterus in, 462.
in double uterus, 278.
irregular pains in first stage of, 454.
irregular pains in second stage of, 459.
irregular pains in third stage of, 461.
quinia in, 458.
treatment of, 456, 459, 462.
with short cord, 560.
temperature in, 130, 464.
theory of causes of, 127.
time of beginning of, 108–111, 123.
tumors, ovarian, in, 550.
tumors, uterine, complicating, 542.
unnatural, 169.

Labor:
urine, increase of, in, 136.
uterine contractions in, 127, 131, 135, 462.
uterine retraction in, 138.
uterine ligaments:
contraction of, in, 128.
uterus, descent of, in, 130.
vagina, influence of, on, 129, 131.
Laceration:
at vaginal orifice, 484, 536, 622, 625.
in foot and breech cases, 383.
of cervix, in labor, 105, 131, 203, 354, 372, 377, 453, 539, 540, 620.
treatment of, after labor, 224.
of frænulum in labor, 134, 622.
of genital canal, 610.
of perinæum, 134, 203, 210–214, 224, 249, 622.
treatment of, after labor, 224.
of uterus, 610, 620.
of vagina, 453, 484, 543, 621, 622.
of vestibulum, 622.
Lactation, 246.
fever of, 247.
in cholera, 264.
insanity of, 701, 703.
of pregnancy, 94, 701.
Laminaria tents, 353.
Lanugo, 62, 64, 65, 68.
Laparo-elytrotomy, 436, 447.
details of operation for, 449.
hæmorrhage, control of, in, 449, 451.
history of, 447.
prognosis of, 448.
in contracted pelvis, 494.
Laparotomy (*vide* gastrotomy):
in extra-uterine pregnancy, 343, 344, 346.
in puerperal peritonitis, 699.
in uterine rupture, 618.
Lateral plates, 49.
Laxatives:
in albuminuria, 578.
in *icterus neonatorum*, 251.
in puerperal fever, 696.
in puerperal state, 254.
Leeches:
fecundation of ovum of, 44.
in puerperal fever, 695.
Length of fœtus at term, 69.
Levator ani, 159, 214.
Ligamenta lata, 14.
Ligaments:
broad, 14.
contraction of, in labor, 128.
pelvic, 146.
pubo-vesical, 161.
recto-uterine, 15.
round, 16.
sacro-sciatic, 147.
Ligaments:
uterine, contraction of, in labor, 128.
vesico-uterine, 15.
Ligamentum:
arcuatum, 470.
ovarii, 16.
teres, 16.
Ligation, late, of cord, 216 *et seq.*
Linea alba, post partum, 249.
Linea terminalis, 144, 151.
Lip, anterior cervical, obliteration of, in pregnancy, 83, 105.
uterine atresia, by, 540.
Lips, development of, 64.
Liquor amnii, 61.
escape of, in abortion, 320.
Lithopædion, 303, 327, 337, 340.
Liver:
acute atrophy of, 266.
disease of, causing abortion, 310.
degeneration of fetal, 555.
Lochia, 241, 245, 249, 252, 255, 684, 689.
alba, 245.
in abortion, 320, 325.
in cholera, 263.
lactea, 245.
quantity of, 245.
rubra, 245, 255.
serosa, 245.
Locking:
of children in multiple pregnancies, 234.
of forceps, 372.
Locomotion:
impeded, in labor, 130.
in pregnancy, 88.
Longings in pregnancy, 90, 112.
Lungs, development of, 48.
abortion from disease of, 310, 351, 359.
capacity of, in pregnancy, 90.
Lusk's modified Tarnier forceps, 378, 379.
Lutein cells, 40.
Lying-in period:
duration of, 255.
Lymphatics of uterus, 28, 77.
inflammation of, in puerperal fever, 657, 679.
of pelvis, in pregnancy, 29.

Maceration:
of fœtus, 304.
Magnesia, for emesis, 121.
Malarial fever complicating pregnancy, 122, 264.
causing abortion, 264.
in puerperal state, 653.
Malformations (*vide* monstrosities):
of child, 556.
Mamma:
acini of, in pregnancy, 87, 247.

Mamma:
anatomy of, 87, 246.
areola of, 88, 90.
in pregnancy, 87, 88, 90, 94, 99, 105.
in puerperal state, 249.
secondary, 88.
changes of, in pregnancy, 87, 88, 90, 94, 99, 105.
diseases of, 706 *et seq.*
in case of fetal death, 106.
lines on, in pregnancy, 88, 105.
nipple, erectility of, 88.
secretion of milk in, 246.
signs of pregnancy relating to, 87, 88, 90, 94, 105.
veins of, in pregnancy, 87, 94, 99.
Mania (*vide* insanity):
etiology of, 569, 701, 702.
in pregnancy, 91, 114.
prognosis of, 702.
puerperal, 701.
treatment of, 702.
Manipulation, conjoined, in pregnancy, 104.
Marasmus, in pregnancy, 114, 118.
Mare's chorion, villi of, 55.
Marginal insertion of cord, 298.
Marital relations in pregnancy, 113, 116, 317.
Mastitis, parenchymatous, 709.
abscesses in, 709.
Maternity hospitals, appointments of, 686.
Meatus urethræ, 5.
Meconium, 62, 69, 199, 259, 641.
Mechanism:
abnormal, in vertex presentations, 179.
of abnormal face presentations, 188.
of breech presentations, 199, 487.
of breech presentations, irregularities in, 201.
of brow presentations, 194.
of dilatation of cervix, 131.
of face presentations, 184, 186.
of labor, 140, 171.
effect of contracted pelvis on, 484, 495.
of normal labor, 171.
of occipito-posterior positions, 179.
with monsters, 557.
Medulla, development of, 50.
Medulla, of ovary, 23.
Medullary folds, 48, 49.
Medullary groove, 49.
Medullary tube, 50.
Melancholia (*vide* insanity):
in pregnancy, 91, 701, 703.
treatment of, 702.
Membrana granulosa, 37, 38.
Membrana propria, 36, 37.
Membrane, mucous:
of cervix, 19, 81, 95.
of ovary, 23, 36.
Membrane, mucous:
of tubes, 21, 42, 329.
of uterus, 18–20, 77, 81, 242.
of vagina, 10, 85, 104.
Membranes:
adhesion of, 455.
artificial rupture of, in labor, 208, 580.
preservation of, in face presentations, 191.
retention of, in abortion, 312.
rupture of, in abortion, 320.
rupture of, to produce abortion, 353, 360.
rupture of, in placenta prævia, 606.
spontaneous rupture of, 132, 140, 208.
Memory in pregnancy, 91, 114, 567, 569, 701.
Meningitis in puerperal fever, 669.
Menses:
diminution of, from fear, 93.
suppression of, in pregnancy, 92, 93, 99.
Menstruation, 39 *et seq.*
last, as aid to prediction of date of confinement, 108.
Mesenteric folds, 50.
Mesoblast, 47, 48, 49, 50.
Metritis, as result of retroflexion of gravid uterus, 279, 280.
calomel in, 464.
from retention of fœtus, 306, 513.
in contracted pelvis, 492.
in labor, 464.
in puerperal fever, 657.
in transverse presentations, 564.
Micrococci:
action of, on the blood, 664.
in lochia, 245.
in puerperal fever, 660, 666 *et seq.*, 681.
Micropyle of Keber, 43.
Migration of ovum, 41, 51.
time required for, 42.
Milk, 94, 99, 246.
absence of, in pregnancy, 94.
anatomical considerations relating to, 246.
condensed, 258.
composition of, 248.
fever, 247.
in albuminuria, 577.
in breasts of new-born, 250.
in women not pregnant, 94.
-metastases, 661.
of one cow, 257.
peptonized, in emesis, 118, 119.
of good wet-nurse, 256.
preparation of, for infants, 257, 258.
secretion of, 246.
defective, 706.
sterilization of, 258.
transfusion of, 590.
uterine, 55, 56.
Milk-leg, 704 (*vide phlegmasia alba dolens*).

Miscarriage, 307 (*vide* abortion).
treatment of, 326.
Missed labor, 304, 305.
Mola, 312.
carnosa, 312.
sanguinea, 312.
Mole, hydatidiform, 231, 298.
anatomy, morbid, of, 298.
diagnosis, 301.
etiology, 300.
prognosis, 301.
symptoms, 301.
treatment, 302.
Monstrosities, 556.
acardiacus, 557.
acephalus, 558.
acormus, 559.
amorphus, 558.
anencephalus, 559.
diagnosis of, 556.
hemicephalus, 559.
mechanism of labor with, 557.
prognosis in cases of, 557.
Mons Veneris, 2.
Morbus coxarius, causing pelvic deformities, 516.
Morning-sickness of pregnancy, 90, 93, 99, 116.
treatment of, 116, 118.
Morsus diaboli, 20.
Morula, 46.
Morphia (*vide* opium):
in anæmia, cerebral, 590.
in chorea, 275.
in eclampsia, 579.
in emesis, 117, 119.
in extra-uterine pregnancy, 345.
in neuralgia, 122.
in *post-partum* hæmorrhage, 585, 590.
in precipitate labor, 453.
in protracted labor, 457, 462, 502.
in puerperal fever, 695.
in shock, 650.
in vaginal thrombus, 628.
Mouth, development of, 48, 63, 64.
Movements, fetal, in pregnancy, 64, 76, 96, 98, 99, 100, 106.
active, 96.
movements of pelvic joints, 148, 275.
passive, 96.
simulation of, 96.
Mucous membrane:
changes in, in pregnancy, 19, 81, 95.
of cervix, 19, 81, 85.
of Fallopian tube, 21, 42, 329.
of milk-ducts, 247.
of os, in pregnancy, 19, 81, 95.
of ovary, 23, 36.
of uterus, body of, 18, 242.
of vagina, 10, 85.
Mucous plug, 81.
Müller, ducts of, 30.
ring of, 84, 85.
Multiparæ, pregnancy in, 105.
Multiple pregnancies, 228.
acardia in, 229.
conduct of labor in, 236.
development of children in, 229, 231.
diagnosis of, 232.
entrance, simultaneous, of both children into pelvis, in, 234.
fœtus papyraceus in, 231.
forceps in, 235.
frequency of, 228.
hæmorrhage in, 236.
labor in, 232.
locking of children in, 234.
management of, 228, 236.
mummification of fœtus in, 303, 306.
origin of, 228.
premature labor, indicated by, 351.
presentations in, 233.
prognosis in, 236.
treatment of, 236.
varieties of, 228.
version in, 236.
weight of children in, 231.
Mummification of fœtus, 303, 306.
Muscles:
action of abdominal, in labor, 129.
development of, 48.
pelvic, 157.
recti, in pregnancy, 87.
uterine, 16, 77, 78.
hyperplasia of, 77, 78, 124.
Myomata, uterine, 542 (*vide* uterus, myomata of).
diagnosis of, from pregnancy, 101.

Naboth, ovula of, 19, 81.
Naegele oblique pelvis, 514.
forceps, 364.
method of computing date of confinement, 109.
Nails, development of, 48, 64, 65.
Narcotics:
in anæmia, cerebral, 590.
in chorea, 275.
in eclampsia, 578, 579.
in emesis, 117.
in lacerations of perinæum, 624.
in neuralgia, 122.
in painful first stage, 463.
in phlegmasia, 705.
in *post-partum* hæmorrhage, 590.
in protracted first stage, 456.
in protracted third stage, 462.
in puerperal fever, 695.
in puerperal insanity, 703.

Nates, changes in, in pregnancy, 87, 105.
Nausea, of pregnancy, 90, 93, 99, 116, 117.
  in eclampsia, 567.
  in shock, 649.
Navel:
  changes of, in pregnancy, 87, 100.
  of new-born child, 250.
  relation of fundus to, in pregnancy, 111.
Neck, development of, 64.
Negresses, areola of, 88.
Neoplasmata:
  placental, 289.
  uterine atresia from, 541, 542, 547.
  vaginal atresia from, 538.
Nephelis vulgaris:
  fecundation of ova of, 44.
Nephritis, indicating abortion, 351.
  in eclampsia, 571.
  in pregnancy, 272.
Nerve exhaustion and shock, 648.
  etiology, 648.
  treatment, 650.
Nerves of uterus, 27, 77.
Nervous system:
  development of, 48, 50.
  diseases of, in pregnancy, 88, 91, 114, 122.
Neuralgia in pregnancy, 88, 91, 114, 122.
New formations in placenta, 289.
Newly born child, 250 (*vide* infant).
  asphyxia of, 215, 368, 635.
  breasts of, 250.
  caput succedaneum of, 181, 190, 250.
  cardiac ventricle of, 250.
  care of, 256, 356.
  circulation of, 216, 250.
  desquamation of, 250.
  ductus arteriosus of, 250.
  feces of, 251.
  foramen ovale of, 250.
  icterus of, 219, 250.
  milk prepared for, 257, 258.
  navel of, 250.
  nurse for, selection of, 256.
  nursing of, 254.
  ophthalmia of, 712.
  size of, 69.
  urine of, 250.
  weight of, 69, 251.
Nipples:
  changes in, during pregnancy, 88, 90, 94.
  cracked, 708.
  erectility of, 88
  erosions of, 707, 708.
  fissured, 707.
  sore, 255, 706.
    shields for, 255, 708.
    treatment of, 707.
Nose, development of, 48, 64.
Notches, sacro-sciatic, 145.
Nucleus, vitelline, 45.
Nurse, wet, selection of, 256.
Nursing:
  contra-indications for, 254.
  in pregnancy, 254.
  intervals for, 254.
Nutrition in pregnancy, 89, 90, 91.
Nux vomica in nausea of pregnancy, 117.
Nyctalopia:
  in pregnancy, 91.
  in puerperal state, 568.
Nymphæ, 3 (*vide* Labia minora).
  sebaceous glands of, 5.
Nymphomania, 702.

Obliquity, lateral, of Nægele, 170.
Obstructed labor, due to—
  abdominal tumors of fœtus, 554.
  abnormaties of fœtus, 551 *et seq.* (*vide* fœtus).
  acardiacus, 557.
  anchylosis of fœtal joints, 556.
  arm, extended, 394.
  ascites, fetal, 554.
  atresia, uterine, 539 (*vide* atresia).
  atresia, vaginal, 536.
  atresia, vulvar, 535.
  bladder, distended, 554.
  calculi, 537.
  coiling of cord, 204, 215, 296.
  cystocele, 555.
  displacements, uterine, 116, 278 *et seq.*, 310.
  ectopia of abdominal organs, 556.
  encephalocele, congenital, 553.
  feces, impacted, 208.
  fatty growths, 555.
  fibrous growths, 538.
  hernias, vaginal, 538.
  hernias, visceral, 556.
  hydrocephalus, fetal, 551.
  hydrothorax, fetal, 554.
  hymen, persistent, 535.
  hypertrophy of cervix, 282, 542.
  knots of cord, 295.
  locked twins, 234.
  monstrosities, 556.
  morbid growths of genital canal, 535 *et seq.*
  multiple pregnancy, 234.
  ossification of fontanelles, premature, 551.
  ovarian tumors, 548.
  perinæum, rigid, 368, 459, 536.
  rigor mortis, fetal, 556.
  short cord, 559.
  spina bifida, 556.
  transverse presentations, 560.
  tumors, intrapelvic, 532, 542.
Obturator foramen, 152.
Occipito-posterior positions:
  forceps in, 379.

Occipito-posterior positions:
mechanism of, 179.
rotation in, 175.
Odontalgia in pregnancy, 91.
Œdema:
cerebral, in eclampsia, 575.
cervical, in labor, 540.
indicating abortion, 351.
in eclampsia, 567, 577.
in labor, 130, 368, 620.
in maceration of fœtus, 304.
in pregnancy, 88, 114, 115, 130, 268, 273, 279, 549, 567.
placental, 288.
vulvar, in labor, 130, 536.
vulvar, in pregnancy, 88, 114, 273, 279.
Oöphoritis, in puerperal fever, 668.
Oösperm, 45.
Operation:
for Cæsarean section, 439.
for causing premature labor, 351, 360.
for cephalotripsy, 425.
for embryotomy, 413, 431.
for extraction of fœtus in breech presentations, 382 *et seq.*
for lacerated perinæum, 623.
for perforation in craniotomy, 414, 428.
for producing abortion, 351.
Porro's, or ovaro-hystorectomy, 442.
details of, 443.
Fehling's modification of, 444.
history of, 442.
Thomas's, or laparo-elytrotomy, 436, 442.
details of, 449.
hæmorrhage, control of, in, 449, 451.
history of, 447.
prognosis of, 448.
Ophthalmia neonatorum, prophylaxis of, 712.
Opiates:
in abortion, 318, 323.
in anæmia, cerebral, 590.
in chorea, 275.
in eclampsia, 579, 581.
in emesis, 117, 119.
in insomnia, 122.
in lacerated perinæum, 624.
in mastitis, 710.
in neuralgia, 122.
in painful first stage, 463.
in peritonitis, 464.
in phlegmasia alba dolens, 705.
in *post-partum* hæmorrhage, 585, 590, 591.
in precipitate labor, 453.
in protracted labor, 457, 462.
in puerperal fever, 695.
in puerperal state, 252.
in shock, 650.
in vaginal thrombus, 628.
Opisthotonus, in eclampsia, 568.
Organs of generation:
abnormities of, 535.
anatomy of female, 1.
changes in, during pregnancy, 77 *et seq.*
development of, 29.
external, 1.
Orifice, oral, development of, 48, 63, 64.
Orificium vaginæ, 6, 7.
Os innominatum, anatomy of, 142.
Osteomalacia:
pelvic deformity from, 529 (*vide* pelvis, deformed, osteomalacic).
pseudo-, 478, 533.
Osteophytes in pregnancy, 89.
Os tincæ, 12.
internum, 13.
closure of, during pregnancy, 82, 85.
Os uteri:
changes of, in pregnancy, 80–86, 95, 105.
in puerperal state, 243.
dilatation of, in labor, 131, 137.
causes of, 137.
in emesis, 119.
elongation of anterior lip of, in labor, 540.
erosions on, during pregnancy, 81, 243.
mucous membrane of, 19, 81, 95.
œdema of anterior lip of, in labor, 540.
rigidity of, atresia from, 540.
thrombus of, in labor, 540.
Ova, number of, 41.
primordial, 36, 38.
Ovarian:
cysts, diagnosis of, from pregnancy, 101, 550.
pregnancy, 327, 334, 338.
tumors, diagnosis of, 549.
tumors, obstructing labor, 548.
Ovaries:
anatomy of, 21.
arteries of, 25.
cortical substance of, 23.
development of, 30.
discharge of ovum from, 39.
epithelium, cylindrical ciliated, in, 23, 36.
erectility, theoretical, of, 27.
follicles of, 23, 36–39.
hilum of, 22.
ligament of, 16, 21.
medullary substance of, 23.
peritonæum, relations of, to, 22.
Porro's operation to remove, 442.
position of, in pregnancy, 79.
relation to Wolffian bodies, 30.
tumors of, in pregnancy and the puerperal state, 548.
diagnosis of, 549.
tunica albuginea of, 23.
veins of, 26.
Ovariotomy, in pregnancy, 550.

Ovaritis, puerperal, 668.
Ovaro-hystorectomy, 442.
details of, 443.
Fehling's method in, 444.
Frank's method, 445.
history of, 442.
Ovula of Naboth, 19, 81.
Ovulation, 39.
suppression of, in pregnancy, 93.
Ovum:
abdominal plates of, 49.
amnion of, 50.
anatomy of, 38, 62.
area germinativa of, 47, 50.
embryonic, 47, 48, 52.
blastodermic vesicle of, 47, 50.
changes in, subsequent to fecundation, 44.
chorda dorsalis of, 49.
chorion of, 51, 53, 64.
cleavage of, 46.
deutoplasm of, 39, 45.
development of, 35, 62.
discharge of, from ovary, 39.
discus proligerus of, 37, 38, 39.
diseases of, 284.
dorsal plates of, 49, 62.
embryonic area of, 47, 62.
epiblast of, 47, 48.
epithelium, cylindrical ciliated, in, 37.
fecundation of, 42–44.
-forceps, in abortion, 324.
germinative spot of, 39.
germinative vesicle of, 39, 45.
disappearance of, 45.
hypoblast of, 47, 48.
membrana granulosa of, 37, 38.
mesoblast of, 47, 48.
micropyle in, 43.
migration of, 41, 51, 328.
morula of, 46.
polar globule of, 45.
premature expulsion of, 307 (*vide* labor, premature).
primitive trace of, 48.
primordial, 36, 38, 39.
pronucleus of, 45.
removal of retained, 321.
segmentation of, 46.
size of, 38
time for migration of, 42.
tubus medullaris of, 50.
umbilical vesicle of, 50.
vitelline membrane of, 38.
vitellus of, 39.
yolk of, 39.
zona pellucida of, 38.
Ovum-forceps:
use of, in abortion, 324.
Oxygen, in nausea of pregnancy, 117.

Oxytocics:
after normal labor, 224.
contra-indications for, 461.
in abortion, 320, 321, 323, 351.
indications for, 224, 460.
in parturition, 224, 461.
in placenta prævia, 603, 606.
in *post-partum* hæmorrhage, 585.
in protracted first stage of labor, 457, 458.
physiological action of, 460.

Pack, wet, in puerperal fever, 698.
in albuminuria, 578.
Pad, antiseptic, 225, 253, 688, 691.
Pains:
action of, on uterine walls, 128.
after-, 224, 244, 252, 672.
anomalies of, 452.
causes of, 130.
character of, 129, 130, 452, 454.
contracted pelvis, affecting, 481.
duration of, 128.
effect of chloroform on, 227.
effect of, on fetal heart, 97.
good, 452, 454, 482.
in abdominal walls, during pregnancy, 87.
in abortion, 311.
in breasts during pregnancy, 87, 94, 99.
in first stage, 131.
in second stage, 133.
irregular, in first stage, 454.
irregular, in second stage, 459.
irregular, in third stage, 461.
labor-, 127, 129, 452, 454, 482.
influence of contracted pelvis on, 479.
influence of, on organism, 130.
premonitory, 131.
seat of, 130.
strong, 452.
weak, 452.
forceps for, 368.
Palate, development of, 64.
Palpation, abdominal, in pregnancy, 100.
vaginal, 99, 103.
Palpitation of heart in pregnancy, 114, 292.
Pancreas:
dilatation of fetal, 555.
Papillæ, vaginal, hypertrophy of, in pregnancy, 86, 105.
Paquelin's thermo-cautery, in Thomas's operation, 450.
Parametritis from retroflexed gravid uterus, 280.
in contracted pelvis, 492.
in puerperal fever, 657, 658, 672.
Paresis in pregnancy, 91.
Parturition, 123 (*vide* labor).
Patches, brown, in pregnancy, 91.
Pathology of labor, 452.

Pathology of pregnancy, 260.
Pelvic abscess, 674, 700.
Pelvic brim, 151, 154, 157, 169 (*vide* brim, pelvic).
Pelvic cavity, general direction of, 151, 153.
Pelvic cellulitis, in puerperal fever, 658.
Pelvic measurement, 467.
  external, 467.
  instruments for, 467.
  internal, 469.
  of conjugata vera, 151, 469, 470.
  of diagonal conjugate, 469, 470.
  of external conjugate, 469.
  of transverse diameter, 471.
Pelvic peritonitis in puerperal fever, 659, 668, 672.
Pelvic walls, length of, 150.
Pelvimeter, 467.
  circle of Baudelocque, 467.
  Schultze's, 467.
  the hand as, for internal measurements, 469.
Pelvimetry :
  external, 468.
  instruments for, 467.
  internal, 469.
Pelvis :
  abscess in, 674, 700.
  adult, causes of its conformation, 155.
  æquabiliter justo-minor, 465, 471, 485, 495, 512.
    diagnosis of, 472.
  agents shaping the adult, 155.
  anatomy of, 140 *et seq.*, 154.
  arteries of, 158.
  articulations of, 145.
    mobility in, 148, 275.
    rupture of, 628.
  as a whole, 149.
  axes of, 150, 152, 153.
  brim of, 151, 154, 157, 169.
    inclination of plane of, 147.
  cavity or canal of, 151, 153.
  conjugate of, 151, 469, 470.
  contracted, 465.
    as indication for abortion, 349, 359.
    Cæsarean section in, 438.
    diagnosis of, 466.
      from history, 466.
      from measurements, 467.
    effects in, of pressure on mother, 488.
    effects in, of pressure on child, 489.
    effects of, on labor, 479.
    extravasations, intra-cranial, in, 491, 498, 506.
    fascia of, 161, 162.
    forms of, three principal, 471.
    fractures in, 491.
    frequency of, 466.
    generally, 477.
Pelvis, contracted :
  influence of, in pregnancy and labor, 479.
    on cranial bones, 490.
    on first stage, 483.
    on labor-pains, 481.
    on mechanism of labor, 484 *et seq.*
    on position of fœtus, 485, 486.
    on presentations of fœtus, 480, 481.
    on uterus in pregnancy, 480, 612.
  irregularly :
    pseudo-osteomalacia, 478, 533.
    kyphosis, 479.
    rachitis, 478.
    scoliosis, 479.
  labor, at term, in, 502.
  prognosis in, 492.
  scalp-tumor in, 483, 489.
  symmetrically, 471, 474.
  treatment in, 486, 493.
    by Cæsarean section, 494, 499, 513, 518, 521, 524, 528, 533.
    by craniotomy, 494, 499, 510, 513, 519, 521.
    by forceps, 497, 503, 508, 511.
    by laparo-elytrotomy, 494.
    by premature labor, 500.
    by version, 498, 499, 503 *et seq.*
    expectant, 509.
    when child can not be delivered through natural passages alive, 494.
    when child may be delivered through natural passages alive, 500.
    when craniotomy or abortion must be performed, 497.
  varieties of, 465.
deformed, rare forms of, 514.
deformed by—
  absence of symphysis, 534.
  exostosis, 533.
  fractures, 533.
  morbus coxæ, 516.
  osteomalacia, 529.
  rachitis, 475, 478.
diameters of, 150 *et seq.*, 157, 169.
difference between—
  adult and infantile, 155.
  female and male, 154.
exostosis of, 533.
exudations in, treatment of, 700.
fascia of, 161, 162.
female, 154, 156.
flattened, 465, 469, 474, 512.
  general, 465, 477, 512.
  mechanism of labor, in, 484 *et seq.*
  non-rachitic, 474.
  rachitic, 475.
    diagnosis of, 477.
    irregular, 478.
  simple, 465, 512.

Pelvis:
floor of, 159, 160.
forceps at brim of, 375.
at outlet of, 368.
funnel-shaped, 528.
inclination of, 147.
inclined planes of, 153.
justo-minor, 465, 471, 485, 495, 512.
kyphotic, 479, 519.
treatment of, 521.
large, the, 149.
ligaments of, 146.
lymphatics of, in pregnancy, 29.
male, 154.
measurements of, 467, 469.
movements in joints of, 148, 275.
muscles of, 157 *et seq.*
Naegele's oblique, 514 (*vide* oblique).
nana, 472.
osteomalacic, 529.
anatomy, morbid, of, 530.
diagnosis of, 532.
etiology of, 531.
prognosis of, 532.
treatment of, 532.
oblique, of Naegele, 514.
anatomy, morbid, of, 514.
diagnosis of, 517.
etiology of, 516.
mechanism of labor in, 517.
prognosis in, 518.
treatment in, 518.
outlet of, 152, 159.
outlet of, forceps at, 368.
planes of, 150.
inclined, 153.
pressure of contracted, on cranium, 490.
pseudo-osteomalacic, 478, 533.
rachitic, 475, 478.
relaxation of symphysis of, in pregnancy, 275.
Robert's anchylosed and transversely contracted, 523.
anatomy, morbid, 523.
diagnosis, 524.
etiology, 524.
prognosis, 524.
scoliotic, 479.
scolio-rachitic, 521.
small, the, 150.
soft parts of, 157.
spondylisthetic, 525.
anatomy, morbid, 525.
diagnosis, 526.
etiology, 526.
prognosis, 527.
straits of, 151, 152.
symphysis of, relaxation in, 275, 628.
absence of, 534.
Pelvis:
tumors of, indicating abortion, 359, 533.
veins of, 158.
walls of, their length, 150.
Penis, development of, 64.
Pepsin, in nausea of pregnancy, 117.
Perforation, 413.
extraction of child after, 419.
by forceps, 419.
by cephalotribe, 420.
indications for, 413, 497, 617.
in face presentations, 418.
instruments for, 414 (*vide* perforators).
of after-coming head, 418.
of uterus, from pressure, 610.
operation, how performed, 414.
point for, 418.
preparations for, 414.
Perforator, 414.
Blot's, 415.
Hodge's cranial scissors, 415.
Simpson's, 414, 415.
Smellie's scissors, 414.
Thomas's, 416.
trephine, 416, 419.
Pericarditis, in puerperal fever, 680.
fetal, obstructing labor, 554.
Perimetritis, in contracted pelvis, 492.
in retention of fœtus, 313.
in puerperal fever, 672.
Perinæum:
body of, 162, 164.
connective tissue of, 164.
dilatation of, in labor, 134.
fascia of, 161.
gangrene of, 536.
in labor, 134.
laceration of, in labor, 134, 203, 211, 224, 453, 622.
muscles of, 162, 164, 214.
preservation of, in labor, 193, 210 *et seq.*
rigidity of, obstructing labor, 368, 459, 536.
thrombus of, 625.
treatment of lacerated, 224, 623.
in labor, 224.
in puerperal state, 224, 249.
Period, lying-in, duration of, 255.
placental, of labor, 134.
Peritonæum, relations of, to ovaries, 22.
Peritonitis, as result of incarceration of retroflexed gravid uterus, 280.
after labor, 464, 492, 534.
in abortion, 313, 325, 355.
in atresia, 541.
in extra-uterine pregnancy, 339, 340.
in ovarian tumors, 549.
in puerperal fever, 659, 668, 672, 677, 680.
in retained fœtus, 306, 313.

Pessary, in retroversion and retroflexion of gravid uterus, 116, 278, 317.
Phantom tumors, differentiation of, from pregnancy, 102.
Phlebitis and phlebo-thrombosis in puerperal fever, 660, 680.
Phlebotomy in eclampsia, 579, 581.
Phlegmasia alba dolens, 646, 701, 704.
abscesses in, 705.
etiology, 704.
history, clinical, of, 705.
origin of, 704.
prognosis of, 705.
treatment of, 705.
Phthisis complicating pregnancy, 270.
abortion in, 270.
Physician, visits of, during the puerperal state, 252.
Piles, in pregnancy, 88, 115.
Pilocarpine, in salivation, 121.
Pinces hémostatiques, 622.
Placenta:
adherent, 221, 462, 593.
anatomy of, 51, 54.
anomalies of, 287.
in circulation, 288.
in development, 288
in form, 287.
in position, 288.
apoplexy of, 288.
arteries of, 58, 59.
artificial separation of, 593, 604.
battledoor, 298.
bruit of, 24, 98.
calcareous degeneration of, 289.
cotyledons of, 56, 59.
arteries of, 59.
cystic degeneration of, 289, 299.
degenerations of, 289, 317, 351.
in cholera, 263.
development of, 54, 64.
expression of, by Credé's method, 220, 324, 462.
in tardy labor, 463.
expulsion of, physiology of, 221.
fatty degeneration of, 289, 351.
fetalis, 56.
fully developed, 58.
functions of, 59.
in abortion, 324, 325.
in Cæsarean section, 440.
infarctions of, 288.
inflammation of, 289, 290, 304.
in multiple pregnancy, 232.
membranacea, 288.
new growths in, 289.
normally implanted hæmorrhages from, 606.
œdema of, 288.
Placenta:
prævia, 594.
abortion in, 597, 600.
accouchement forcé in, 602, 603.
anæmia in, 598.
cervix in, 600.
clinical features of, 596.
diagnosis of, 599.
dilator, Barnes's in, 602 *et seq.*
douche in, 606.
ergot in, 603, 606.
etiology of, 596.
fœtalis, 56.
forceps in, 375, 603.
frequency of, 595.
hæmorrhages in, 597, 599, 601, 605.
history, clinical, of, 596.
indicating abortion, 351.
presentations, abnormal, in, 598.
prognosis of, 599, 600, 605.
pyæmia in, 599.
situation of, 594.
tampon in, 601.
thrombi in, 238, 249, 599.
treatment of, 600, 601.
by Barnes's dilator, 602, 604.
by detachment of placenta, 604.
by ergot, 603, 606.
by forceps, 603.
by tampon, 601, 604.
by version, 602, 603.
varieties of, 595.
retained, 221, 461, 462, 581, 584, 586, 592.
in abortion, 312, 325.
prevention of, 221, 463.
treatment of, 325, 351, 463, 593.
site of, *post-partum*, 242, 249.
spuria, 288.
structure of, fully developed, 58.
succenturiata, 288, 586.
syphilis of, 272, 290.
thrombosis of sinuses of, 288.
tumors in, 289.
uterina, 57.
vascular spaces of, 57.
villi of, 54–57, 290.
in cat, 56.
in mare, 55.
Placentitis: 289, 290, 304.
abortion in, 289, 304.
Planes of pelvis, 150, 153.
Plates:
abdominal, 49.
dorsal, 49, 62.
lateral, 49.
Plethora of pregnancy, 88.
Pleurisy, chronic, complicating pregnancy, 270.
Pleuritis, in puerperal fever, 669, 680.

Pleurosthotonus, in eclampsia, 568.
Plexus:
hypogastric, 27.
pampiniformis, 25.
uterinus, 25.
magnus, 27.
Plicæ:
recto-uterinæ, 15.
vesico-uterinæ, 15.
Plug, mucous, of cervix, 81.
Plural pregnancy, 228 (*vide* pregnancy, multiple).
Pneumonia, acute lobar, complicating pregnancy, 269, 359.
Podalic version, 401, 404.
Polar globule, 45.
Polypus, fibrinous, removal of, 326.
causing puerperal hæmorrhages, 592.
in abortion, 313.
simulating menses, 93.
vulvar, 536.
Porro's operation, 442 (*vide* ovaro-hystorectomy).
details of, 443.
Fehling's modification of, 444.
Frank's modification of, 445.
history of, 442.
in uterine tumors, 545, 548.
Porte-fillet, 392.
Portio vaginalis of cervix, 12.
lacerations of, 620.
Positions:
changes of, 76.
classification of, 170.
definition of, 76.
diagnosis of, 183.
first, 76.
for examination, in pregnancy, 99.
forceps, use of, in occipito-posterior, 379.
in breech presentations, 197.
in contracted pelvis, 486.
in multiparæ, 75.
in primiparæ, 75.
mento-posterior, forceps in, 381.
oblique, as cause of face presentations, 184.
occipito-anterior, 170.
occipito-posterior, 170, 179.
forceps in, 379.
lacerations in, 214.
mechanism of, 179.
rotation in, 175.
transverse, forceps in, 381.
second, 76.
Post-partum hæmorrhage, 581 (*vide* hæmorrhage, *post-partum*).
Posture:
in first stage of labor, 208.
in second stage of labor, 209, 210.
Præputium clitoridis, 4.
Prague method of extraction with head at the brim, 399.
Precipitate labor, 453 (*vide* labor, precipitate).
Pregnancy:
abdomen in, 86, 94, 99, 100, 105, 278.
abdominal, 42, 327, 335, 339.
collapse in, 338.
definition of, 327.
diagnosis of, 280, 340.
electricity in, 345.
elytrotomy in, 346.
hæmorrhage in, 327, 346.
injections into sac in, 345.
interstitial, 332.
intraligamentous, 331.
laparotomy in, 343, 344, 346.
ovarian, 327, 328, 338.
peritonitis in, 339, 340.
puncture of sac in, 345.
recurrence of, 328.
secondary, 339.
septicæmia in, 340.
symptoms of, 338.
terminations of, 327, 333, 339.
treatment, 343.
of advanced cases, 346.
of cases prolonged after death of fœtus, 348.
of early cases, 343.
tubal, 327, 328.
tubo-abdominal, 338.
tubo-ovarian, 338.
acardia in multiple, 229.
accidental complications of, 260.
air, fresh, in, 112.
albuminuria in, 91, 262, 268, 273, 275, 567, 569, 577.
alimentation, rectal, in, 119.
amaurosis in, 91.
amblyopia in, 91.
amenorrhœa in, 92, 93.
amniotic fluid obscuring, 95.
anæmia in, 114, 122.
anæsthesia in, 91, 102.
anodynes in, 117, 119.
anorexia in, 114.
anteflexion in, 116, 278.
anteversion in, 80, 278.
appetite in, 90, 114.
areola in, 88, 90, 94, 99, 240.
ascites, in, 102.
auscultation in, 96, 102, 106.
auscultatory signs of, 96, 102, 106.
ballottement in, 96, 101, 104.
bladder and rectum, functional disease of in, 88.
blood-changes of, 88, 113, 115.
bowels in, 90, 118.

Pregnancy:
breasts in, 87, 88, 90, 94, 99, 105, 106.
brown patches in, 91.
bruit, uterine, in, 96, 98, 103.
cancer of cervix in, 546.
carbonic dioxide, increase of, in, 89.
cardiac diseases in, 89, 266.
carunculæ in, 105.
cathartics in, 115.
cephalalgia in, 122.
cervical, 309, 596.
changes, in abdominal walls in, 87.
in blood in, 88, 113, 115.
in breasts in, 87, 88, 90, 94, 99, 105, 106.
in cervix uteri in, 80–86, 95, 105, 116.
in entire organism in, 88.
in heart in, 89.
in hips in, 86.
in nates in, 87, 105.
in navel in, 87, 100.
in nipple in, 88, 90, 94.
in os uteri in, 80–86, 95, 105.
in sexual apparatus and neighboring organs in, 77, 105.
in thighs in, 87.
in thyroid in, 89.
in umbilicus in, 87.
in uterus in, 77, 105.
in vagina in, 85, 105.
in vulva in, 86, 105.
in walls, abdominal, in, 87, 100, 105.
character in, 91.
cholera complicating, 263.
chorea complicating, 114, 274.
circulation, disorders of, in, 114, 115.
coiling of cord complicating, 296.
coitus in, 113, 116.
complicated by:
albuminuria, 91, 262, 268, 273, 275, 567, 569, 577.
amaurosis, 91.
amblyopia, 91.
anæmia, 114.
anæsthesia, 91.
anomalies of cord, 293.
anomalies of placenta, 287.
anteflexion and anteversion, 80, 116, 278.
ascites, 95.
calcareous degeneration of cord, 298.
cardiac diseases, 89, 266, 310, 351, 359.
cephalalgia, 122.
cholera, 263.
chorea, 114, 274.
circulatory disorders, 114, 115.
coiling of cord, 296.
constipation, 88, 90, 116, 118, 122.
contracted pelvis, 479 *et seq.*
cramps, 88.
cysts in cord, 297.
deafness, 91.
death of fœtus, 106.
deficiency of amniotic fluid, 293.
delirium, 118.
diabetes, 274.
diarrhœa, 90, 118.
dizziness, 91.
dropsy, 114.
dyspnœa, 90, 114, 292, 351, 549, 567.
eclampsia, 567.
emesis, 93, 99, 116, 117.
emphysema, 270.
empyema, 270.
endometritis, 272, 284–286.
exanthemata, 260.
face-ache, 91, 122.
flatulence, 112.
gangrene, 115.
goitre, 89.
headache, 122.
heartburn, 112, 121.
heart-disease, 89.
hernias of cord, 296.
hernias of uterus, 283.
hydatidiform mole, 298.
hydræmia, 89, 115.
hydramnion, 95, 103, 290.
hyperosmia, 118.
hypertrophy of heart, 89.
hysteria, 114.
icterus, 266.
incontinence of urine, 88, 278.
indigestion, 88, 90, 114, 118.
insanity, 91, 114, 701.
insomnia, 122.
knots in cord, 295.
locomotion, impaired, 88.
maceration of fœtus, 304.
malarial fever, 122, 264.
mania, 91, 114.
measles, 261.
missed labor, 304, 305.
mummification of fœtus, 303, 306.
nausea, 90, 93, 99, 116, 117.
nephritis, chronic, 272.
neuralgia, 88, 91, 114, 122.
œdema, 88, 114, 115, 130, 268.
osteophytes, 89.
palpitation, 114.
paresis, 91.
phthisis, 270.
placentitis, 289, 290.
plethora, 88.
pleurisy, chronic, 270.
pneumonia, 269.
prolapse of uterus, 282.
prolapse of vagina, 283.
pruritus, 91, 121.

Pregnancy, complicated by:
relapsing fever, 264.
retention of dead fœtus, 302.
retroflexion, 279.
retroversion, 279.
rubeola, 261.
salivation, 90, 94, 178, 121.
scarlatina, 262.
stenosis of umbilical vessels, 297.
syncope, 91, 114, 118.
syphilis, 271.
taste, perversions of, 91, 118.
torsion of cord, 293, 303.
tumors, ovarian, 548.
tumors, uterine, 542, 546.
typhoid fever, 264.
typhus fever, 264.
varicose veins, 88, 115.
variola, 261.
vertigo, 91, 114, 118.
vomiting, 90, 93, 99, 116, 117, 359.
complications of, accidental, 260.
constipation in, 88, 90, 116, 118, 122.
contractions of uterus in, 101, 131.
cravings in, 91, 118.
deafness in, 91.
delirium in, 118.
diabetes in, 274.
diagnosis of, 91.
diagnosis of dead fœtus in, 106.
diagnosis, differential of, 101 *et seq.*
diagnosis of multiple, 232.
diarrhœa in, 90.
diet in, 112, 114, 117.
digestion in, 90, 93, 114, 116, 464.
discoloration of skin in, 91.
disorders of, 113.
distinction between first and second, 104.
dizziness in, 91, 114, 118.
dolores presagientes in, 131.
douche, vaginal, in, 113.
dress in, 113.
dropsy in, 88, 114, 115, 130, 279, 567.
dropsy of amnion in, 95, 103.
duration of, 62, 106, 123.
dyspnœa in, 90, 114.
eclampsia in, 567.
effects of, on nervous system, 91, 114, 122.
electricity in, 117.
emesis in, 93, 99, 116 *et seq.*, 280.
emphysema complicating, 270.
empyema complicating, 270.
endometritis during, 272, 284.
ergotin in, 116.
exanthemata in, 260.
exercise in, 113, 122.
exploration, methods of physical, 99.
extra-uterine, 280, 327.
face-ache in, 91, 122.
Pregnancy:
fetal heart-sounds in, 96, 97, 101, 103, 106.
flatulence in, 112.
fœtus, death of, in, 106.
frœnulum in, 105.
frequency of multiple, 228.
funic souffle in, 98.
gangrene in, 115.
hæmoglobin in, 89.
hæmorrhoids in, 88, 115, 130.
heart-burn in, 112, 121.
heart, hypertrophy of, in, 89.
heart-sounds, fetal, in, 96, 97, 101, 103, 106.
hernia, of cord in, 296.
of uterus in, 283.
hips in, 86.
hydræmia in, 89, 115.
hydræmic œdema in, 88, 114, 115, 130, 279.
hydramnion in, 95, 103, 290.
hygiene of, 112.
hymen in, 105.
hyperosmia in, 118.
hysteria in, 114.
ice, use of, in, 117, 119.
icterus complicating, 266.
impaired digestion in, 88, 90, 114.
incontinence of urine in, 88.
increase in size of abdomen in, 86, 94, 99, 100, 105.
in one-horned uterus, 232.
in double uterus, 277.
in multiparæ 105.
in primiparæ, 105.
insalivation in, 90, 94, 99, 121.
insanity in, 91, 114, 701.
insomnia in, 122.
inspection of abdomen in, 100.
interrogation of patient in, 99.
interruption, premature, of, 597.
interstitial, 332.
irritability in, 113.
iron in anæmia of, 114, 122.
journeys in, 113.
kiesteine in, 94.
knots in cord, complicating, 295.
labia in, 86.
lactation in, 94.
locomotion in, 130.
"longings" in, 90, 112.
lungs, capacity of, in, 90.
malarial fever in, 122, 264.
mammæ in, 87, 88, 90, 94, 99, 105, 106.
management of, 112.
mania in, 91, 701.
marasmus in, 114, 118.
marital relations in, 113, 116.
melancholia in, 91, 701.
measles in, 261.
memory in, 91, 114.

Pregnancy:
menses in, 92, 93, 99.
methods of physical examination in, 92, 99.
milk in, 94.
morning sickness in, 90, 93, 99, 280.
movements of fœtus in, 75, 95, 96, 98–100, 106.
multiple, 228.
abortion in, 124.
acardia in, 229.
conduct of labor in, 236.
development, unequal in, 229, 231.
diagnosis of, 232.
entrance, simultaneous, of both children into pelvis, in, 234.
fœtus papyraceus in, 231.
frequency of, 228.
hæmorrhage in, 236.
hydramnion in, 291.
labor in, 232.
locking of children in, 234.
management of, 228, 236.
origin of, 228.
placenta in, 232.
premature labor induced in, 351.
presentations in, 233.
prognosis in, 236.
prolapse of cord in, 630.
treatment of, 236.
varieties of, 228.
version in, 23.
weight of children in, 231.
nates in, 87, 105.
nausea and vomiting in, 90, 93, 99, 116.
navel in, 87, 100.
nephritis in, 272.
nerves in, 91.
nervous irritability in, 91, 113, 114.
neuralgia in, 88, 91, 114, 122.
nipple in, 88, 90, 94.
nutrition in, 89–91.
nyctalopia in, 91.
odontalgia in, 91.
œdema in, 88, 114, 115, 130, 268, 273, 279, 567.
osteophytes in, 89.
os uteri in, 80–86, 95, 105.
ovarian, 327, 334.
ovaries, position of, in, 79.
ovariotomy in, 550.
ovulation, suspended, in, 93.
pain, abdominal, in, 87.
mammary, in, 87, 94, 99.
palpation of abdomen in, 100.
palpitation in, 114.
paresis in, 91.
patches, brown, in, 91.
pathology of, 260.
pelvis, contracted, in, 465.
Pregnancy:
pernicious anæmia complicating, 114.
pessaries in, 116.
phthisis complicating, 270.
physical exploration in, 99.
physiology of, 77.
piles in, 88, 115.
placentitis in, 289.
plethora of, 88.
pleurisy complicating, 270.
pneumonia complicating, 269.
prediction of end of, 108, 111.
premature labor, in anæmia of, 115.
prolapse of uterus and vagina in, 282, 359.
pruritus in, 91, 121.
pulse in, 89, 118.
puncture in œdema of, 115.
quickening in, 95, 96, 98, 99, 101, 110.
rectal touch in, 104.
relapsing fever complicating, 264.
relaxation of symphysis in, 275.
respiration in, 90, 118.
retardation of menses in, 92.
retroflexion in, 116, 279, 307, 310.
incarcerated, 280.
retroversion in, 116, 279, 480, 542.
rubeola complicating, 261.
salivation in, 90, 94, 99, 118, 121.
scarlatina complicating, 262.
secretions in, 114.
senses in, 91.
signs of, 92 *et seq.*
size of uterus in, 77, 80, 100, 110, 130.
skin, care of, in, 113, 118.
smell, perversion of, in, 91.
souffle, funic, in, 98.
sounds, use of, in, 101.
speculum, use of, in, 104.
spots, cutaneous, in, 91.
striæ, abdominal, in, 87, 100, 105.
striæ, mammary, in, 87, 105.
suppression of menses in, 92, 93, 99.
surgical operations during, 276.
sympathetic diseases in, 93.
syncope in, 91, 114, 118.
syphilis, complicating, 271.
taste, perversions of, in, 91.
temperature in, 118.
thighs in, 87, 105.
thirst, in, 118.
thorax in, 90.
thrill, uterine, in, 100.
thyroid gland in, 89.
tooth-ache in, 91.
torsion of cord in, 295, 303.
transfusion in, 114.
tubal, 327, 328.
tubo-abdominal, 338.
tubo-ovarian, 334, 338.

Pregnancy:
tumors, uterine, complicating, 542.
tympanites in, 102.
typhoid fever complicating, 264.
typhus fever complicating, 264.
umbilicus in, 87, 100.
urethra in, 105.
urination, frequency of, in, 88, 280.
urine, increase of, in, 91.
uterine bruit in, 96, 98, 103.
uterus in, 77, 80, 95, 101, 105, 110, 116.
vagina in, 85, 104, 105.
vaginal touch in, 99, 103.
varicose veins in, 88, 115.
variola complicating, 261.
veins in, 94.
vertigo in, 91, 114, 118.
vomiting in, 90, 93, 116, 280, 359.
vulva in, 86, 104, 105.
weight in, 90, 114.
Precipitate labor, 453.
Premature labor, 307, 349, 500 (*vide* labor).
Preparations for labor, 205.
Presentations, 72, 168.
breech, 169, 197, 382.
anæsthesia in, 383, 387.
armamentarium for, 384, 388.
arms, liberation of, in, 394.
breech, extraction by, 385.
blunt hook in, 388, 393.
causes of, 197, 481, 552.
changes of, 75.
configuration of fœtus in, 202.
contracted pelvis, influence of, on, 481, 487.
cord in, 204, 393, 630, 635.
definition of, 72.
diagnosis of, 191, 198.
exceptional cases of, 395.
extraction in, 382 *et seq.*
extraction of head in, 396, 398.
feet, extraction by, 384.
forceps to after-coming head in, 399.
fillet in, 388, 391.
forceps to breech in, 388.
frequency of, 197.
heart-sounds in, 103.
in contracted pelvis, 481.
in maceration of fœtus, 395.
in twin labors, 288.
irregularities in mechanism of, 201.
knee, diagnosis of, from elbow, in, 199.
liberation of arms in, 394.
management of cord in, 393.
mechanism of, 199, 487.
membranes, bag of, in, 198.
mistaken for face, 191.
operation of extraction in, 382 *et seq.*
Prague method of delivering head in, 398
Presentations:
prognosis in, 203.
release of arms in, 394.
rotation of fœtus in, 199, 395.
traction, direction of, in, 385.
treatment of, 204, 456.
trunk, delivery of, 384.
brow, 169, 194.
anæsthetics in, 196.
causes of, 194, 481, 487, 510.
diagnosis of, 194.
forceps in, 197.
head, configuration of, in, 194.
prognosis in, 195.
treatment of, 196, 456.
cause of predominating, first, 170.
cephalic, 169.
diagnosis of, 182.
classification of, 169.
cranial, diagnosis of, 182.
face, 169, 184.
causes of, 184, 481, 487.
configuration of head in, 189.
cord, prolapse of, in, 635.
craniotomy in, 381, 418.
descent of fœtus in, 186.
diagnosis of, 190.
extension of fetal head in, 186.
external rotation in, 188.
flexion in, 188.
forceps in, 381.
frequency of, 184.
heart-sounds in, 103.
in contracted pelvis, 481.
influence of contracted pelvis on, 481.
mechanism of, 184, 186.
abnormal, 188.
membranes, preservation of, in, 191.
mistaken for breech, 191.
perforation in, 418.
prognosis in, 191.
rotation in, 187.
treatment of, 191, 456.
Schatz's method in, 192.
foot, 169, 202, 481.
extraction in, 382 *et seq.*
funis, 629.
head, 72, 169.
causes of, 72.
diagnosis of, 182.
heart-sounds in, 103.
knee, 202.
natural, 169.
normal, 169.
pelvic, 169, 382.
extraction in, 382.
preponderance of head, 72.
shoulder, 169, 456, 481, 498, 561, 612.
version in, 498.

Presentations:
transverse, 169, 560, 564.
embryotomy in, 432.
version in, 404, 406.
unnatural, 169, 543, 598.
vertex, 169, 170, 179.
configuration of head in, 180.
diagnosis of, 182.
frequency of, 169.
theories to account for preponderance of, 72–74.
Pressure of uterus in labor, 140.
Primiparæ, signs of pregnancy and parturition in, 105.
Primitive groove, 48.
Primitive streak, 48.
Primitive trace, 48.
Primitive vertebræ, 49.
Primordial ovum, 36, 38, 39.
Prolapse:
of cord, 629.
of gravid uterus, 282.
causing abortion, 282.
of vagina in pregnancy, 283, 557.
Promontory, false, 470.
Promontory, of sacrum, 141.
Pronucleus:
female, 45.
male, 45.
Pruritus in pregnancy, 2, 91, 121.
Pseudo-osteomalacic pelvis, 478, 533.
Psoas abscess in puerperal fever, 677.
Pubes, anatomy of, 140, 144, 150, 155.
Pudendum, definition of, 1.
rima of, 2.
Puerperal diseases, 653.
Puerperal eclampsia, 567 (*vide* eclampsia).
Puerperal fever, 653.
abscesses in, 659–661, 674, 675, 677, 680, 699, 700.
alcohol in, 697.
analogy between it and surgical fever, 662, 664.
anodynes in, 695.
antisepsis in, 687, 690.
aspiration in, 700.
atmospheric causes of, 681.
auto-inoculation in, 684, 690.
bacilli, in, 666.
bacteria in, 666 *et seq.*, 681.
blood-poisoning in, 664 *et seq.*
causes of, 495, 547, 681.
inoculation, 683.
cellulitis in, 657, 658.
chills in, 671, 673, 676, 678–680.
classification of lesions of, 655.
clinical history of, 671 *et seq.*
symptoms of endocolpitis and of endometritis, 671.
Puerperal fever:
symptoms of general peritonitis, 677.
symptoms of parametritis, 672.
symptoms of perimetritis, 672.
symptoms of septicæmia, 679.
definition of, 653.
diphtheritic patches in, 656, 657, 679, 686.
emboli in, 660, 680.
endocarditis in, 669.
endocolpitis in, 656, 671.
endometritis in, 656, 671.
erysipelas, how related to, 686.
frequency of, 653.
germs in, 666 *et seq.*
history, clinical, of, 671.
infarctions in, 668.
infection, sources of, in, 663.
inflammation:
of genital mucous membrane in, 655.
of peritonæum, uterine, 655, 659, 672, 677.
of subserous pelvic cellular tissue in, 655, 659.
of uterine parenchyma in, 657.
inoculation of, 683.
lesions of, 655.
meningitis in, 669.
metritis in, 657.
micrococci in, 660, 666, 668, 669, 679, 681.
microspores in, 666, 681.
morbid anatomy of, 655.
mortality of, 653, 686.
nature of, 661, 664.
non-bacteritic variety of, 670.
œdema in, 667.
oöphoritis in, 659, 668.
origin, non-local, of, 662.
pains in, 672 *et seq.*
parametritis in, 657, 658, 672.
pathological anatomy of, 655.
pelvic cellulitis in, 658.
perimetritis in, 672.
peritonitis, general and pelvic, in, 659, 668, 672, 677, 680.
phlebitis in, 660, 680.
phlebo-thrombosis in, 660, 680.
pleuritis in, 669, 680.
prevention of, 686.
pulse in, 672, 673, 678–680.
pyæmia in, 660, 680.
relations of, to zymotic diseases, 685.
salpingitis in, 656.
sapræmia in, 661.
scarlatina in, 263, 653.
seasons, relations of, to, 685.
septicæmia in, 655, 660, 679, 681.
lymphatica, 679.
pure, 681.
venosa, 680.
sewers, affecting, 691.

Puerperal fever:
social state, relation of, to, 685.
symptoms of, 671.
temperature in, 671 *et seq.*
theory of milk metastases in, 661, 664.
thrombi in, 660.
treatment of, 686, 692.
by alcohol, 697.
by anodynes, 695.
by antipyretics, 696, 697.
by antipyrine, 697.
by baths, 698, 699.
by cauterizing ulcers, 693.
by cold, 697.
by curette, 614.
by digitalis, 697.
by douche, intra-uterine, 693, 694.
by douche, vaginal, 687, 688, 692, 699.
by enemata, 687.
by laparotomy, 699.
by laxatives, 696.
by leeches, 695.
by opium, 695.
by poultices, 695.
by quinia, 696,
by salicylate of soda, 696.
by stupes, 695.
by veratrum viride, 697.
by Warburg's tincture, 697.
by wet-pack, 698.
treatment of peritoneal effusions, 699, 700.
tympanites in, 678, 679.
ulcers in, 656, 679.
vibrios in, 666, 681.
virus of, 666.
vomiting in, 674, 678.
zymotic diseases, relations of, to, 635.
Puerperal state, 238.
abdomen in, 249.
after-pains in, 224, 244, 252.
air in, 253.
anæmia in, 645.
anodynes in, 252.
anteflexion in, 244, 249.
antisepsis in, 253, 688.
appetite in, 240.
bandage in, 255.
binder in, 224.
bowels in, 240.
breasts in, 249.
care of, in, 255.
cancer, uterine, in, 547.
care of patient in, 224.
catheterism in, 252.
cervix uteri in, 243, 249, 547.
chill in, 238.
closure of sinuses in, 243.
collapse in, 648.
convulsions in, 567 *et seq.*, 581.
cystitis in, 252.
death in, 645.
decidua, reparation of, in, 241.
diabetes in, 240.
diagnosis of, 249.
diet in, 253.
douche in, 224, 253.
duration of, 255.
eclampsia in, 567, 581.
embolism in, 645.
enemata in, 254.
ergot in, 224.
fevers in, 653.
general functions in, 240.
hæmorrhoids in, 254.
hymen in, 249.
insanity in, 701.
involutio uteri in, 240.
iodoform in, 592, 688, 700.
labia in, 249.
laxatives in, 254.
lochia in, 241, 245, 249, 255.
loss of weight in, 135, 240.
malaria in, 653.
management of, 238, 251.
milk-fever in, 247.
milk, secretion of, in, 246,
nursing in, 254.
pad, antiseptic in, 225, 253.
passing urine in, 252.
perinæum in, 224, 249.
physiology of, 238.
placental site in, 249.
pulse in, 239, 248, 645.
relation of, to pathological conditions, 238.
retention of urine in, 240.
scarlatina in, 262, 653.
secretion of milk in, 246.
separation of decidua in, 242.
shock in, 648.
sinuses, closure of, in, 243.
sleep in, 251.
syncope in, 645.
temperature in, 239, 247.
thrombosis in, 238, 645.
treatment of, 238, 251, 687 *et seq.*
tumors, ovarian, in, 550.
tumors, uterine, complicating, 542, 547.
urine in, 240, 252.
uterus, position of, in, 244, 249.
involution of, in, 240.
vagina in, 105, 244, 249.
vaginal ulcers in, 693.
visits of physicians in, 252.
vulva in, 249, 693.
washing of vagina in, 224, 253.
weight, loss of, in, 135, 240.

Pulse:
in eclampsia, 568.
in labor, 130, 645.
in placenta prævia, 598.
in *post-partum* hæmorrhage, 590.
in pregnancy, 89, 118.
in puerperal fever, 672 *et seq.*
in puerperal state, 239, 248, 645.
in pulmonary thrombosis, 647, 648.
in shock, 649.
in uterine inversion, 608.
in uterine rupture, 615.
Pupils in eclampsia, 567.
Puncture, in œdema of pregnancy, 115.
followed by premature labor, 115.
in extrau-terine pregnancy, 344.
Pyæmia, bacteria in, 660, 668, 680.
in phlegmasia, 705.
in placenta prævia, 599.
in puerperal fever, 660, 680.

Quadruplets, 228, 230.
Quickening, 95, 96, 99, 101, 110.
date of, 95, 110.
Quinine:
as antiphlogistic, in puerperal fever, 696.
in cephalalgia, 122.
in chorea, 275.
in mastitis, 710.
in phlegmasia, 706.
in pneumonia, 270.
in protracted first stage, 457, 458.
Quintuplets, 228.

Rachitis, deforming pelvis, 466, 472, 475, 478.
Râles, laryngeal, in delivery, 215.
Rectal enemata:
in anæmia, 114, 118.
in emesis, 118, 119.
in labor, 208.
Rectal touch, in pregnancy, 104.
Rectocele, atresia, vaginal, from, 537, 623.
Rectum, development of, 63.
in labor, 456.
in pregnancy, 88.
Relapsing fever, complicating pregnancy, 264.
Repercussion (*vide* ballottement).
Reposition of cord, 631.
of uterus, in retroflexion, 280, 281.
Repositor:
Braun's, 411.
catheter used as, 412, 634.
in version, 411.
Respiration:
artificial, in *asphyxia neonatorum*, 643.
Schultze's method, 643.
Sylvester's method, 644.
in pregnancy, 90, 118.
Respiration:
intra-uterine, 638.
physiology of, 635, 638.
Restitution, in face presentations, 188.
in vertex presentations, 178 (*vide* external rotation).
Retained placenta, 221, 225, 461, 581, 584, 586, 592 (*vide* placenta, retained).
Retention:
in utero, of dead fœtus, 302.
of urine—
in labor, 208, 537.
in pregnancy, 208, 280.
in puerperal state, 240, 252.
Retinitis, in nephritis, 273.
Retraction ring, 137, 138.
Retraction, uterine, 137, 454, 459, 582, 584.
Retractores uteri, 15.
Retroflexion of gravid uterus, 116, 279, 307, 310, 480, 542, 549, 592.
abortion in, 310.
with incarceration, 280, 359, 480.
diagnosis, 280.
treatment, 280, 316, 359.
Retroversion of gravid uterus, 116, 279, 480, 542, 592.
Ribs, development of, 64.
Rickets, causing pelvic deformity, 466, 472, 475 (*vide* rachitis.)
Rigid os, atresia from, 540.
Rima pudendi, 2.
Ring of Bandl, 84, 137, 611.
Ring of Müller, 84, 85.
Ring, retraction or contraction, 137, 138.
Robert's anchylosed pelvis, 523.
Rotation of fetal head, 173.
conditions of, 174.
excessive, in breech presentations, 202.
explanation of, 175.
external, in normal labor, 177.
in breech presentations, 200, 396.
in brow presentations, 194.
in face presentations, 187.
in vertex presentations, 173, 177.
Rubeola complicating pregnancy, 261.
with pneumonia, 261.
Rupture:
in extra-uterine pregnancy, 338.
at orifice of vagina, 484, 536, 622, 625.
of cervix, 105, 203, 539, 540, 620.
of genital canal, 610.
of membranes, 132, 140, 208.
to produce premature labor, 353, 360.
of pelvic articulations, 628.
of perinæum, 134, 203, 211, 224, 453, 622.
of uterus, 610 (*vide* uterus, rupture of the).
in contracted pelvis, 481.
of vagina, 621.
of vestibule, 622.

Sac :
injections into, in extra-uterine pregnancy, 345.
puncture of, in extra-uterine pregnancy, 344.
Sacro-iliac articulation, 145.
rupture of, 628.
Sacrum, 141, 154.
alæ of, 141.
anatomy of, 141.
dimensions of, 142.
hiatus sacralis of, 142.
lineæ transversæ of, 141.
male and female, 154.
superficies auricularis of, 142.
Salicylate of soda in puerperal fever, 696.
Salivation in pregnancy, 90, 94, 99, 118, 121, 181.
Salpingitis, causing tubal pregnancy, 328.
in puerperal fever, 656.
Sapræmia in puerperal fever, 661.
Scalp-tumor, 190, 250, 369, 483, 489.
in brow presentations, 194.
in face presentations, 190.
Scarlatina :
in pregnancy, 262.
puerperalis, 262, 653.
Schultze's diagram for computing pregnancy, 109.
Scirrhus of uterus, obstructing labor, 541, 547 (*vide* atresia, uterine).
Scolio-rachitic pelvis, 479, 521.
Scoliotic pelvis, 479.
Scrotum, development of, 64, 65.
Seasons, relation of, to puerperal fever, 685.
Sebaceous glands :
of areola, 88.
of fœtus, 68.
of labia, 5.
of nymphæ, 5.
Secondary areola, 88, 94, 99.
Section, Cæsarean, 436 (*vide* Cæsarean section).
Secretion :
disorders of, in pregnancy, 114.
of milk, 246.
Segmentation of ovum, 46.
Semen, 43.
Senses, special, affections of, in pregnancy, 91.
Septicæmia :
albuminuria in, 680.
bacteria in, 666 *et seq.*
in abortion, 313, 325.
in atresia, 541.
in extra-uterine pregnancy, 340.
in ovarian tumors, 549, 550.
in puerperal fever, 655, 660, 679–681.
in retention of dead fœtus, 306, 313.
in transverse presentations, 564.
Septicæmia :
in *tympanites uteri*, 652.
in uterine cancer, 547.
in vaginal thrombus, 626.
lymphatica, 679.
pure, 681.
symptoms of, 679 *et seq.*
venosa, 680.
vibrios in, 666.
Septum :
recto-vaginale, 9.
laceration of, 623.
urethro-vaginale, 9.
Serous lochia, 245.
Serres fines, in perineal laceration, 625.
Serre-nœud, 444.
Sex, prediction of, 97.
Sexual organs, abnormities of, 535.
changes in, in pregnancy, 77, 105.
Shield, nipple, 255, 708.
Shock, and nerve exhaustion, 492, 495, 549, 608, 615, 620, 648.
anodynes in, 650.
in artificial abortion, 353.
Shortening, apparent, of cervix in pregnancy, 81.
explanation of, 83.
Shoulder presentations, 169 (*vide* transverse presentation).
Shoulders, delivery of, 178, 199, 215.
in breech cases, 396.
Signs of pregnancy, 92 *et seq.*
auscultatory, 96, 102, 106.
Simpson's forceps, 364, 379.
Simpson's perforator, 414.
Sinciput, 70.
Sinus urogenitalis, 33.
Sinuses, closure of, in puerperal state, 238, 243.
formation of, 24.
uterine, 24, 59, 77, 125, 238.
Skin, development of, 48, 64.
care of, in pregnancy, 113, 118.
Skull, development of, 64.
Sleep in puerperal state, 251.
Sleeplessness in pregnancy, 122.
Smegma præputii, 5.
Smell, perversion of, in pregnancy, 91.
Smellie's scissors, 414.
Social state, relation of, to puerperal fever, 685.
Soda in pruritus, 121.
Sopor in eclampsia, 568.
Souffle, funic, 98.
uterine, 98, 103.
Sounds, use of, in pregnancy, 101, 341, 360.
Speculum, use of, in craniotomy, 428.
in diagnosis of pregnancy, 104.

Spermatozoa, 43.
locomotion of, 43.
Sphenotribe, 431.
Sphincter vaginæ, 9.
Spina bifida, as obstruction to labor, 556.
Spinal column, articulation of fetal head with, 168.
development of, 48, 64.
Spinous processes of ilia, distance between, 144, 150, 468.
of ischia, 145, 153.
Spleen:
enlargement of fetal, 555.
in puerperal fever, 671.
Spondolisthetic pelvis, 525.
Sponges, aseptic, preparation of, 360, 439.
Sponge-tents, use of, in abortion, 353, 360.
Spontaneous amputation, intra-uterine, 296.
Spontaneous evolution, 364 (*vide* evolution).
Spontaneous version, 562 (*vide* version).
Spot:
embryonic, 47, 48, 62.
germinative, of ovum, 39.
Spots, cutaneous, in pregnancy, 91.
Stage of labor:
effect of contracted pelvis on first, 483, 495, 502.
irregular pains in first, 454.
irregular pains in second, 459.
irregular pains in third, 461.
management of first, 208.
management of second, 209.
delivery of shoulders in, 178, 199, 215.
preservation of perinæum in, 210 *et seq.*
tying cord in, 215, 236.
management of third, 220.
treatment of long first, 456.
by anodynes and anæsthetics, 456.
by Barnes's dilators, 457.
by bougies, 457.
by douche, vaginal, 457.
treatment of long second, 459.
Staphylococci in puerperal fever, 666.
State, the puerperal, 238.
abdomen in, 249.
after-pains in, 224, 244, 252.
air in, 253.
anodynes in, 252.
anteflexion in, 244, 249.
appetite in, 240.
bandage in, 255.
bowels in, 240.
breasts in, 249.
care of, 255.
catheterism in, 252.
cervix, the, in, 243, 249.
chill in, 238.
closure of sinuses in, 243.
complicated by scarlatina, 262.
State, the puerperal:
cystitis in, 252.
decidua, reparation of, in, 241.
diabetes in, 240.
diagnosis of, 249.
diet in, 253.
duration of, 255.
enemata in, 254.
general functions in, 240.
hæmorrhoids in, 254.
hymen in, 249.
involution in, 240.
labia in, 249.
laxatives in, 254.
lochia in, 241, 245, 249, 255.
loss of weight in, 135, 240.
management of, 238, 251.
milk, secretion of, in, 246.
milk-fever in, 247.
nursing in, 254.
passing urine in, 252.
perinæum in, 224, 249.
physiology of, 238.
placental site in, 249.
pulse in, 239, 248.
relations of, to pathological conditions, 238.
reparation of decidua in, 241.
retention of urine in, 240.
scarlatina in, 262.
secretion of milk in, 246.
sinuses, closure of, in, 243.
sleep in, 251.
temperature in, 239, 247.
thrombosis of placental vessels in, 238.
treatment of, 238, 251.
tumors, uterine, complicating, 542.
urine, passing of, in, 240, 252.
retention of, in, 240.
uterus, position of, in, 244, 249.
involution of, in, 240.
vagina in, 105, 244.
visits of physician in, 252.
washing vagina in, 224, 253.
weight, loss of, in, 135, 240.
Stenosis, of umbilical vessels, 297.
Stethoscope, use of, in diagnosis of pregnancy, 102.
Stigma folliculi, 39.
Still-births, 635.
Stillicidium in placenta prævia, 598.
Stimulants:
in abortion, 323.
in cephalalgia, 122.
in cerebral anæmia, 590.
Stockings, elastic, in pregnancy, 116.
Stomach, development of, 48, 50.
Strait:
axis of inferior pelvic, 153.
axis of superior pelvic, 152.

Strait:
circumference of inferior, 152.
circumference of superior, 152.
forceps at, 355.
inferior pelvic, 152.
superior pelvic, 151.
Striæ:
abdominal, in pregnancy, 87, 100, 105.
mammary, in pregnancy, 88, 105.
on nates and thighs, in pregnancy, 87, 105.
Stump, treatment of, in Porro's operation, 446.
Styptics:
in *post-partum* hæmorrhage, 587, 622.
in puerperal hæmorrhage, 592.
in puerperal state, 693.
Subinvolution after abortion, 314.
Sugar in urine, *post-partum*, 240.
Superfetation, 231 (*vide* pregnancy, multiple).
Superficies auricularis, 142.
Surgery, obstetric, 349.
Surgical operations:
abortion from, 276.
during pregnancy, 276.
prognosis, 276.
time for, 277.
Suspended animation, 635 (*vide asphyxia neonatorum*).
Sutures, 70, 165.
coronal, 70, 166, 183.
frontal, 70, 165.
in Cæsarean section, 441.
in hydrocephalus, 552.
in uterine rupture, 400, 621.
lambda, 70, 166, 183.
premature ossification of, 551.
sagittal, 70, 183.
Symphysis pubis, 145, 154, 471.
absence of, 534.
anatomy of, 145.
in male and female, 154.
relaxation of, in pregnancy, 148, 275.
rupture of, 628.
Synchondrosis, sacro-iliac, 145.
motion at, 275.
rupture of, 628.
Syncope:
in childbed, 645.
in labor, 134, 645.
in *post-partum* hæmorrhage, 590.
in pregnancy, 91, 114, 118.
Syphilis:
causing abortion, 272, 308, 350.
complicating pregnancy, 271.
of placenta, 290.

Tampon:
in abortion, 320, 322, 323, 324, 326, 355.
in hydatid mole, 302.
Tampon:
in placenta prævia, 601, 604.
in uterine prolapse, 282.
in vaginal prolapse, 283.
method of applying, 322, 323.
to produce premature delivery, 355.
uterine, in hæmorrhage, 592.
Tannin in pruritus, 122.
Tardy labor, 453 (*vide* labor, tardy).
Tarnier's forceps, 377-379, 390, 400.
Tarnier's incubator, 358.
Taste, perversions of, in pregnancy, 91.
Taylor's forceps, 377, 414, 513.
Temperature:
in labor, 130.
in *post-partum* state, 239.
in pregnancy, 118.
in puerperal fever, 671, 672.
Tenesmus, vesicle, from retroflexed incarcerated gravid uterus, 280.
Tents, in abortion, 121, 324, 353, 360, 602.
in hydatid mole, 302.
Terminal bulbs of clitoris, 3.
Testicle:
development of, 65.
fibro-cystic degeneration of fetal, 555.
Theca folliculi of Graafian follicle, 36, 38.
Thighs, *striæ* on, in pregnancy, 87, 105.
Thirst in pregnancy, 118.
Thomas's operation, 447.
Thorax in pregnancy, 90.
development of, 64.
Thrill in uterine artery during pregnancy, 100.
Thrombus:
arterial, 645.
cardiac, 646.
causing collapse and death in labor and childbed, 645.
in placental vessels, physiological, 238, 249.
in placental sinuses, 288.
in placenta prævia, 599.
in septicæmia, 660.
in veins and lymphatics during phlegmasia, 704.
of cervix, 540.
of labia, 5.
of os, in labor, 540.
of uterine sinuses in labor, 238, 583, 584.
of vagina, 538, 625 (*vide* vagina, thrombus of).
anodynes in, 628.
of vulva, 5, 526, 625 (*vide* vulva, thrombus of).
treatment of pulmonary, 650.
venous, 646, 650.
Thyroid gland, hypertrophy of, in pregnancy, 89.

Torsion of cord, 293, 303.
Touch, vaginal, in diagnosis of pregnancy, 99, 103.
rectal, in pregnancy, 104.
Trace, primitive, 48.
Trachelorrhaphy, to prevent abortion, 318.
Tractions, on forceps, 366.
axis, 390.
direction of, 366, 372, 373, 377.
time for making, 368, 372.
on cord:
in labor, 220, 221.
in retained placenta, 463, 593.
Transforateur, Hubert's, in cephalotomy, 431.
Transfusions of blood and milk in *post-partum* hæmorrhage, 590.
apparatus for, 591.
in anæmia of pregnancy, 114.
in cerebral anæmia, 590.
Transverse diameter of pelvis, 151.
Transverse presentations, 169, 560.
version in, 404, 406.
Transversus perinei, 162, 164, 214.
Trephine-perforator in craniotomy, 416, 419.
Triplets, 228, 230.
Trunk:
delivery of, with crotchet, 430.
expulsion of, in labor, 178, 554.
extraction of, in breech cases, 384.
Truss in hernia of uterus, 284.
Tubal pregnancy, 328.
Tubes, Fallopian, 12, 19, 30.
ampulla of, 19.
anatomy of, 19, 30.
dilatation of, in atresias, 541.
fimbriated extremity of, 19.
isthmus of, 19.
mucous membrane of, 21, 329.
muscles of, 20.
non-erectility of, 41.
ostium abdominale of, 19.
position of, in pregnancy, 79.
Tubus medullaris, 50.
Tumors:
abdominal, diagnosis of, from pregnancy, 102, 549.
fetal, causing dystocia, 554.
fibroid, of uterus, in pregnancy, 102, 542.
indicating Cæsarean section, 438.
intrapelvic, causing atresia, 533, 542.
osseous, deforming pelvis, 533.
ovarian, 548 (*vide* ovary, tumor of).
in parturition, 550.
in pregnancy, 548.
in puerperal state, 550.
obstructing labor, 548.
parametritic, in puerperal fever, 674.
phantom, differentiation of, from pregnancy, 102.
Tumors:
placental, 289.
scalp, 181, 483.
after birth, 250.
in brow presentations, 194.
indicating forceps, 369.
in face presentations, 190.
uterine:
complicating pregnancy, parturition, and puerperal state, 542 *et seq.*
producing atresia, 541, 546.
vaginal, causing atresia, 538.
Tunica:
albuginea of ovary, 23.
fibrosa of Graafian follicle, 36.
propria of Graafian follicle, 36.
Tupelo tents in abortion, 121.
Turning, 400 (*vide* version).
Twin-pregnancy, 228, 230, 233 (*vide* pregnancy, multiple).
Twins, locking of, obstructing labor, 234.
Tympanites:
in Cæsarean section, 441.
in puerperal fever, 676, 677, 679.
mistaken for pregnancy, 102.
uteri, 652.
Typhoid fever complicating pregnancy, 264.
in puerperal state, 653.
Typhus fever complicating pregnancy, 264.
in puerperal state, 653.

Ulcers in puerperal fever, 656, 693.
Umbilical cord, 60 (*vide* funis).
anomalies of, 293.
arteries of, 53, 60, 61, 250.
calcareous degeneration of, 298.
care of, in infants, 256.
coiling of, 204, 215, 296.
cysts in, 297.
degenerations of, 297.
diseases of, 297.
expression of, 630.
formation of, 60.
gelatin of, 61.
hernias of, 296.
in new-born, 250.
knots in, 295.
laceration of, in precipitate labor, 453.
late ligation of, 216, 236.
management of, in breech presentations, 393.
marginal insertion of, 298.
prolapse of, 510, 561, 629.
reposition of, 631.
shortness of, 559.
souffle in, 98.
stenosis of vessels of, 297.
structure of fully developed, 61.
torsion of, 293.

Umbilical cord:
ante-mortem, 295.
tying of, in labor, 215, 236.
vein of, 53, 60.
vessels of, 53, 60.
Umbilical vesicle, 50, 52, 60, 63, 64.
Umbilical vessels, 53, 60, 66.
stenosis of, 297.
Umbilicus:
arteries of, 53, 60, 66.
changes of, in pregnancy, 87, 100.
of new-born child, 250.
Unavoidable hæmorrhage, 597, 605.
Uræmia:
in eclampsia, 571, 576.
in retroflexion, 280.
Urea in amniotic fluid, 61.
Ureter:
dilatation of fetal, 554.
Urethra in pregnancy, 105.
in labor, 134.
Urinary calculus, obstructing labor, 537.
Urination, involuntary, in pregnancy, 88, 280.
frequent, in abortion, 311.
Urine:
albumen in, during pregnancy, 91, 118, 273, 567.
during eclampsia, 567, 569 *et seq.*
during septicæmia, 680.
atresia from retention of, 537.
casts in, in eclampsia, 567.
expulsion involuntary, of, in pregnancy, 88.
incontinence of, 88, 280.
increase of, in labor, 130.
in pregnancy, 91.
in hydramnion, 292.
kiesteine in, 94.
of fetus, 61, 250.
of infant, 250, 251.
passing, in puerperal state, 252.
post-partum, 249.
retention of, in pregnancy, 208, 280, 368, 537.
retention of, in puerperal state, 240, 252.
suppression of, in eclampsia, 573.
Uterine:
atony in double uterus, 278, 540.
in third stage, 461.
bruit, in pregnancy, 96, 98, 103.
douche:
in abortion, 320, 325, 326, 354, 356.
in hydatid mole, 302.
in *post-partum* hæmorrhage, 587.
in puerperal fever, 683, 693, 694.
glands, 18.
inertia, 454, 461.
insufficiency, 454, 457, 461.
pain in pregnancy, 127, 131.
Uterine:
paralysis, 454.
souffle, 98, 103.
tumors obstructing labor, 542.
vessels, air in, 647.
Uterus:
abnormal conditions of, 277.
abnormities of, 33, 260, 277.
action of, in labor, 135.
action of pains on walls of, 128.
amputation of, in rupture, 618.
anatomy of, 10.
anteversion and anteflexion of, 80, 116, 278.
causing abortion, 310.
in puerperal state, 244, 249.
arteries of, 23, 24, 59, 77, 79, 103.
in pregnancy, 77, 79, 95, 101, 105.
internal spermatic, 25.
thrill in, during pregnancy, 100.
uterina hypogastrica, 23.
atresia of, 539 (*vide* atresia, uterine).
atrophy of mucous membrane of, causing abortion, 309.
bicornis, 34.
body of, 12, 18.
bruit in, during pregnancy, 96, 98, 103.
cancer of neck of, 546.
treatment of, 547.
catheterization of, to produce abortion, 352, 580.
causes of enlargement of, 78.
cavity of body of, 13.
center, motor, for contractions of, 126.
cervix or neck of, 12.
changes in, in pregnancy, 77–86, 105, 116, 131, 137.
compression of, in labor, 220.
contractions of, in labor, 127, 311, 454, 582.
contractions of, in pregnancy, 101, 124, 127.
effect of chloroform on, 227.
method of causing, in *post-partum* hæmorrhage, 585.
cordiformis, 34.
corpus of, 12.
cornua of, 33.
curetting of, in puerperal hæmorrhage, 592.
development of, 30.
didelphys, 34.
dilatation of fetal, 555.
dimensions of, *post-partum*, 241, 244, 249.
displacements of gravid, 80, 116, 278, 310, 480.
double, 34, 277, 540.
causing abortion, 278.
drainage of, 618.
duplex, 341, 277, 540.
erectility (theoretical) of, 26.
evacuation of, in abortion, 320, 321.
fluctuation in gravid, 100.

Uterus:
fundus of, 12, 130.
gangrene of, in retroflexion, 280.
glands of, 18.
gravid, 77, 95, 101, 105, 106.
anteversion and anteflexion of, 80, 116, 278.
retroflexion of, 116, 279, 310, 480.
retroversion of, 116, 279, 480.
with incarceration, 280, 359, 480.
growth, early lateral, of, 79, 123.
hernia of gravid, 283.
hour-glass contraction of, 224.
hyperæmia of gravid, 310.
hypertrophy of mucous membrane of, 310.
incarceration of retroflexed, 280, 359.
injections between, and ovum, to produce abortion, 352.
injections into, in *post-partum* hæmorrhage, 587, 589.
in puerperal peritonitis, 678.
in puerperal state, 241, 244, 249.
inversion of, 453, 560, 594, 607.
involution of, 240.
irritability of, in gestation, 127.
laceration of cervix of, 105, 203, 453, 539, 620.
ligaments of, 15, 16.
contraction of, in labor, 128.
lymphatics of, 28, 77.
measurements of gravid, 78.
motor center of, 126.
mucous membrane of, 18–20, 77, 81, 242, 309.
atrophy of, 309.
crypts in, 55, 242.
hypertrophy of, 310.
muscles of, 16.
in pregnancy, 77–86, 124.
myomata of, 542 *et seq.*
treatment of, 543.
nerves of, 27, 77, 126, 311.
neck of, 12.
one-horned, pregnancy in rudimentary cornu of, 332.
os internum of, 13.
paralysis of, 456.
perforation of, from pressure, 620.
peritonæum of, 16, 79.
Porro's operation for removal of, 442.
position of, in puerperal state, 244.
in pregnancy, 75.
post-partum, 244.
prolapse of, complicating pregnancy, 282, 359.
reflex action of, causing vertex presentations, 75, 126.
removal of, by Porro's operation, 442.
retention in, of dead fœtus, 302.
Uterus:
retraction of, 137, 454, 459, 582.
methods to cause, 589.
retroflexion and retroversion of gravid, 116, 279, 359, 480.
treatment of, 280, 316, 359.
rupture of, 353, 387, 400, 410, 412, 443, 481, 484, 492, 540, 542, 553, 610, 620.
clinical history of, 615.
diagnosis of, 615.
etiology of, 611.
pathology of, 614.
treatment of, 616.
semi-partitus, 34.
septus bilocularis, 34.
shape of gravid, 80, 100, 123.
sinking of gravid, 80, 90, 130.
sinuses of, 24, 59, 77, 125, 238.
size of, in hydatidiform mole, 301.
in pregnancy, 77, 80, 100, 110.
post-partum, 242, 244, 249.
softening of, in pregnancy, 194.
thrombi in sinuses of, 583, 599.
tumors of, complicating pregnancy, 542.
causing hæmorrhage, 584.
tympanites of, 652.
unicornis, 34.
veins of, 24, 59, 77.
in pregnancy, 77, 124.
thrombi in, 646, 660.
vessels of, and of its appendages, 23, 124, 242.
weight of gravid, 78, 124.
in puerperal state, 241.
weight of virgin, 78.

Vagina:
absence of, 536.
anatomy of, 8, 162.
arteries of, 10.
atresia of, 536.
accidental, 536.
congenital, 536.
from calculi, 537.
from cystic degeneration, 538.
from cystocele, 537.
from double vagina, 538.
from echinococci, 538.
from neoplasmata, 538.
from prolapse of vagina, 537.
from rectocele, 537.
from retention of urine, 537.
from thrombus, 538, 626.
from vaginal hernia, 537.
from vaginismus, 538.
from vesical calculi, 537.
bulbs of vestibule of, 5, 162.
changes of, in pregnancy, 85, 105, 131.
changes of, in puerperal state, 244, 249.
color of, in pregnancy, 104.

Vagina:
columns of, 9.
constrictor of, 162.
cristæ of, 10, 105.
cystic degeneration of, 538.
development of, 30.
double, 277, 538.
douche in:
in abortion, 320, 322.
in pregnancy, 113, 122.
in puerperal hæmorrhage, 592.
in puerperal state, 224, 253, 693.
in long first stage of labor, 457.
in retained placenta, 594.
to cause abortion, 354, 356.
to prevent puerperal fever, 687, 692, 699.
erectility, theoretical, of, 9.
examination by, in pregnancy, 99, 103, 206.
fornix of, 9.
glands of, 10, 162.
influence of, on labor, 129.
in pregnancy, 85, 104, 105, 131.
in puerperal state, 244, 249.
laceration of, 453, 484, 543, 621.
laceration of orifice of, 484, 536, 622, 625.
muscles of, 9, 162.
in pregnancy, 85.
œdema of, in pregnancy, 114.
orificium of, 6, 7.
papillæ of, 10, 86, 105.
hypertrophy of, 86, 105.
mucous membrane of, 10, 85.
in pregnancy, 85, 104.
neoplasms of, 538.
non-erectility of, 9.
orifice of, 6, 7.
prolapse of, in pregnancy, 283, 537.
from laceration, 623.
sphincter of, 9.
stenosis of, indicating forceps, 368.
structure of walls of, 9.
tampon applied to:
in abortion, 320–324, 326, 355.
in hydatidiform mole, 302.
in placenta prævia, 601.
to produce abortion, 355.
thrombus of, 538, 625.
anodynes in, 628.
atresia from, 538, 625.
Barnes's dilator in, 627.
diagnosis of, 626.
etiology of, 626.
prognosis of, 626.
symptoms of, 625.
treatment of, 627.
ulcers of, 536, 693.
veins of, 10.
Vagina:
in pregnancy, 85, 626.
walls of, their structure, 9.
Vaginal columns, 9.
Vaginal douche, 113 (*vide* douche, vaginal).
Vaginal growths, atresia from, 538.
Vaginal touch, in the diagnosis of pregnancy, 99, 103.
Vaginismus, atresia from, 538.
Vagitus uterinus, 642, 652.
Valve:
Eustachian, 66, 68, 637.
of *foramen ovale*, 66, 68.
Varicose veins in pregnancy, 88, 115.
Variola in pregnancy, 261.
Vaseline in pruritus, 121.
Vectis, 362.
Veins:
cervical, 26.
hæmorrhoidal, in pregnancy, 115.
inflammation of, in puerperal fever, 660.
internal spermatic, 26.
mammary, in pregnancy, 87, 94, 99.
ovarian, 26.
pelvic, 158.
thrombi in, 646, 660.
umbilical, 58, 60, 66, 250.
uterine, 24, 59, 77, 646, 660.
utero-ovarian, 25, 26.
vaginal, 10.
varicose, in pregnancy, 88, 115, 626.
elastic stockings in, 116.
ergotine in, 116.
in vaginal and vulvar thrombus, 626.
Venesection in eclampsia, 579, 581.
in pneumonia, 270.
Ventilation in hospitals, 682, 689.
Veratrum viride:
in eclampsia, 579, 581.
in puerperal fever, 697.
Vernix caseosa, 65, 68.
removal of, 256.
Version, 400.
after complete retraction of uterus, 409.
after craniotomy, 430.
after embryotomy, 432.
after rupture of membranes, 405.
anæsthetics in, 404, 406, 410.
cephalic, 401.
Braxton Hicks's method, 403, 404.
Busch's method, 402.
combined methods, 401, 404.
D'Outrepont's method, 403.
external method, 401.
Hohl's method, 403.
Wigand's method, 401.
Wright's method, 403.
combined, 401, 404.
decapitation in, 413.

Version:
external, 401.
hand employed in, 406, 407.
in accidental hæmorrhage, 606.
in breech and foot cases, 204, 386.
in brow presentations, 196.
in contracted pelves, 498, 499, 503 *et seq.*
in craniotomy, 430.
in death of mother, 651.
in face presentations, 381.
in head presentations, 404.
in heart diseases, 268.
in lateral positions, 407.
in multiple pregnancy, 236.
in placenta prævia, 602, 603.
in prolapse of funis, 631, 633, 634.
in rupture of uterus, 616.
in Thomas's operation, 450.
internal, 401, 405.
in transverse presentations, 404, 406.
in uterine myoma, 545.
neglected, 408.
podalic, 401, 404.
bipolar method, 404.
combined method, 404.
indications for, 404.
repositors, use of, in, 411.
spontaneous, 562.
etiology, 562.
mechanism of complete, 563.
mechanism of partial, 563.
prognosis in, 564.
use of catheter as repositor in, 412.
use of fillet in, 411.
use of repositor, Braun's, in, 411.
Vertebræ, primitive, 49.
Vertex presentation, 169 *et seq* (*vide* presentation, vertex).
Vertigo in pregnancy, 114, 118.
in eclampsia, 567.
Vesicle:
blastodermic, 47, 50.
germinative, of ovum, 39, 45.
disappearance of, 45.
umbilical, 50, 51, 52, 60, 63, 64.
Vesicles, cerebral, 63.
development of, 63.
Vessels:
cervical, 26, 27.
collapse and death from entrance of air into uterine, 355, 647.
umbilical stenosis of, 297.
uterine, 23, 79.
entrance of air into, 355, 647.
Vestibulum, 4.
bulbi of, 4, 622.
glandulæ of, 5, 6.
laceration of, 622.
Vibriones in septicæmia, 666, 681.
Viburnum prunifolium in abortion, 317, 318.
in salivation, 121.
Villi, chorial, 51–53, 56, 64, 289, 329.
abortion from degeneration of, 308.
of cat, 56.
of mare, 55.
placental, 56.
Vinegar in *post-partum* hæmorrhage, 588.
Virus of puerperal fever, 666.
Visceral arches, 63.
Visits of physician in puerperal state, 252.
Vitelline membrane of ovum, 38.
Vitellus, or yolk, of ovum, 39.
appearance of nucleus of, 45.
segmentation of, 45.
Volsella forceps in embryotomy, 432.
Vomiting:
causing hæmorrhage, 585.
in incarcerated retroflexed gravid uterus, 280, 359.
induction of abortion for, 117, 351, 359.
in eclampsia, 567.
in hydramnion, 292.
in pregnancy, 90, 93, 99, 116, 117, 351.
in puerperal fever, 674, 678.
in rupture of uterus, 615.
in shock, 649.
Vulva, 2.
atresia of, 535.
cancer of, 536.
changes in, during pregnancy, 86, 104, 105, 115.
color of, in pregnancy, 104.
connivens, 2.
erosions of, 622.
fourchette of, 4.
frenulum of, 4.
hæmatoma of, 536.
hians, 2.
laceration of, 536, 622.
glands of, 5, 162.
in pregnancy, 86.
œdema of:
in labor, 130, 368, 620.
in pregnancy, 86, 104, 105, 115, 131, 134, 280, 536.
in puerperal state, 249.
polypus of, 536.
pruritus of, 122.
stenosis of, indicating forceps, 368.
thrombus of, 5, 536, 625.
diagnosis of, 626.
etiology of, 626.
prognosis, of, 626.
symptoms of, 625.
treatment of, 627.
ulcers of, in puerperal fever, 656, 693.
varicose veins of, in pregnancy, 88, 104, 115, 626.

Vulvo-vaginal:
follicles, 5, 6.
glands, 5, 6.

Wallace's forceps, 365.
Walls of abdomen obscuring pregnancy, 102.
Waters, false, 562.
Water, hot, in hæmorrhage, 587.
Weight:
gain of, during pregnancy, 90.
loss of, in pregnancy, 114.
loss of, in puerperal state, 135, 240.
of fœtus at term, 69, 251.
of fœtus in multiple pregnancy, 231.
Weight:
of gravid uterus, 78.
of virgin uterus, 78.
Wet-nurse, selection of, 256.
Wet-pack, use of, in puerperal fever, 698.
Wharton's gelatin, 61.
Whisky in *post-partum* hæmorrhage, 590.
White's forceps, 365.
Wolffian bodies, 29.

Yolk of ovum, 39.

Zona pellucida of ovum, 38, 46.
Zymotic diseases, their relation to puerperal fever, 685.

THE END.

A TEXT-BOOK ON THE DISEASES OF WOMEN.

By ALEXANDER J. C. SKENE, M. D.,

Professor of Gynæcology in the Long Island College Hospital, Brooklyn, N. Y.; formerly Professor of Gynæcology in the New York Post-graduate Medical School and Hospital, etc.

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Encyclopædic Medical Dictionary,

BEING A DICTIONARY OF

THE TECHNICAL TERMS USED BY WRITERS ON MEDICINE AND THE COLLATERAL SCIENCES IN THE LATIN, ENGLISH, FRENCH, AND GERMAN LANGUAGES.

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